

EXAMINED.

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17 MAY. 1917
ENTOM.

State of Connecticut

REPORT

OF

The Connecticut Agricultural
Experiment Station

NEW HAVEN, CONN.

SIXTEENTH REPORT OF THE STATE ENTOMOLOGIST, 1916

W. E. BRITTON, PH.D.

BEING PART II OF THE ANNUAL REPORT OF 1916

PART II.

SIXTEENTH REPORT
OF THE
State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to submit the following as my sixteenth report as State Entomologist of Connecticut for the fiscal year ending September 30, 1916. The inspection of the nurseries was not completed before that date, but as it is desirable to have them all in one list, they are included here. The presence of the white-pine-currant blister rust has necessitated extra inspection work, though, as this is a fungous disease, both the botanical and forestry departments have aided in its eradication. The chief entomological features of the year as well as accounts of the routine work of the department, and a few special articles, will be found in the following pages.

Respectfully submitted,

W. E. BRITTON,
State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST
FROM OCTOBER 1ST, 1915, TO SEPTEMBER 30TH, 1916.

RECEIPTS.

From E. H. Jenkins, Treasurer	\$3,750.00
Account of 1915, balance	761.54
State Comptroller, Apiary Inspection Account	10.70
" " Gipsy Moth Control Account	713.00
Miscellaneous sources for lantern slides	2.85
	\$5,238.09

EXPENDITURES.

For Field, office and laboratory assistance:

B. H. Walden, salary	\$1,500.00	
Q. S. Lowry, salary	1,041.65	
M. P. Zappe, salary*	787.49	
Grace A. Foote, salary†	489.86	
Other assistance	41.00	
		\$3,860.00
Printing and illustrations	15.64	
Postage	25.01	
Stationery	13.56	
Telegraph and telephone	4.44	
Office supplies	8.43	
Library	50.53	
Laboratory supplies	49.63	
Express, freight and cartage	3.59	
Tools and supplies	34.25	
Traveling expenses	198.91	
Balance, cash on hand	974.10	
		\$5,238.09

Memorandum:—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts. By provision of the Legislature at its 1915 session, all expenses for the work of suppressing gipsy and brown-tail moths and of inspecting imported nursery stock are paid by order of the Comptroller on receipt of duly approved, receipted, and certified vouchers, and the accounts may be found in the Comptroller's office in the State Capitol at Hartford. The items of \$10.70 and \$713.00 credited above as having been received from the State Comptroller, are not real receipts, but are virtually transfers from other appropriations to cover time expended on work for which such appropriations were made.

SUMMARY OF INSPECTION AND OFFICE WORK.

- 325 samples of insects received for identification.
- 88 nurseries inspected.
- 79 regular nursery certificates issued.
- 19 parcels of nursery stock inspected and certified.
- 23 orchards and gardens examined.
- 291 shipments, containing 2,102 cases, 1,998,178 plants imported nursery stock inspected.
- 94 shipments, or 32.3 per cent. found infested with insects or fungi.
- 467 apiaries, containing 3,898 colonies, inspected.
- 88 apiaries, containing 275 colonies found infested with European foul brood.
- 5 apiaries, containing 6 colonies found infested with American foul brood.

* For ten months.

† For thirty-five weeks.

- 2 apiaries, containing 2 colonies found infested with pickled or sac-brood.
- 2037 letters written on official work.
- 768 post cards written on official work.
- 300 reports of inspection to Federal Horticultural Board.
- 1230 bulletins, etc., mailed on request or to answer inquiries.
- 99 packages sent by mail or express.
- 28 lectures and addresses made at institutes, granges, etc.

PUBLICATIONS OF ENTOMOLOGICAL DEPARTMENT, 1916.

By *W. E. Britton*:

Fifteenth Report of the State Entomologist (Part II. of Station Report for 1915): 112 pages, 6 figures, 16 plates; 10,000 copies distributed in April.

Report of the Committee on Injurious Insects, Proceedings Connecticut Pomological Society, page 35, 5 pages, 1916.

Report of the Committee on Injurious Insects, Proceedings Connecticut Vegetable Growers Association, page 9, 2 pages; page 82, 3 pages; also page 17 "Insects Attacking the Potato," 4 pages, 1915-1916.

Further Notes on *Diprion simile* Hartig, Journal of Economic Entomology, Volume 9, page 281, 2 pages, 1916.

The House Fly as a Disease Carrier and How Controlled (New and revised edition of a paper issued in 1912), Connecticut State Board of Health, 12 pages, 1916.

Report of the Anti-Mosquito Committee of the New Haven County Public Health Association, Monthly Bulletin, Connecticut State Board of Health, 3 pages, September, 1916.

A Dangerous Pine Sawfly (*Diprion simile* Hartig), Tree Talk, Volume 3, page 45, 2 pages, November, 1915.

By *W. E. Britton and Quincy S. Lowry*:

Bulletin 190, Insects Attacking Cabbage and Allied Crops in Connecticut, 23 pages, 17 figures; 10,000 copies distributed in April.

By *B. H. Walden*:

Anti-Mosquito Work in Connecticut, Proceedings Second Annual Meeting New Jersey Mosquito Extermination Association, page 81, 3 pages, 1915.

By *P. L. Buttrick*:

Bulletin 189, A Mosquito Survey at the Mouth of the Connecticut River, 32 pages, 1 map in colors; 2,000 copies distributed in March and April.

DEPARTMENT STAFF.

W. E. BRITTON, Ph.D.	<i>State and Station Entomologist.</i>
B. H. WALDEN, B.Agr.	<i>First Assistant.</i>
QUINCY S. LOWRY, B.Sc.	<i>Assistant.</i>
IRVING W. DAVIS, B.Sc. ..	<i>Assistant and Deputy in Charge of Moth Work.</i>
MAX P. ZAPPE, B.S.	<i>Assistant.</i>
MISS GRACE A. FOOTE, B.A.	<i>Clerk and Stenographer.</i>

H. W. COLEY, Westport {	<i>Apiary Inspectors.</i>
A. W. YATES, Hartford }	

Messrs. Walden, Lowry, Davis, and Zappe have continued as assistants and have aided in the general work of the department, particularly the inspection of nurseries and of imported nursery stock.

Mr. Walden has been in charge of all work during the absence of the Entomologist and has done most of the photographic work of the department which includes the making of negatives, prints, enlargements and lantern slides. He has also devised and made certain pieces of special apparatus for photographic work. He was assigned the inspection of the mosquito drainage work in Branford, Guilford, and Madison, and this occupied most of his time during the summer. He was, however, able to continue certain experiments on the control of the white pine weevil at Rainbow.

Mr. Davis has been in charge of the field work in suppressing the gipsy moth and the brown-tail moth, and has resided in Danielson throughout the entire year, except from August 15 to September 15, when he was in New Haven assisting in the annual inspection of the nurseries of the State. Mr. Davis' salary has been paid by the Comptroller out of the gipsy moth appropriation.

Mr. Lowry has conducted some field experiments in controlling the insects attacking cucumber, squash, and pumpkin at the Station farm at Mt. Carmel. He also investigated an outbreak of the eight-spotted forester, *Alypia octomaculata* Fabr., which occurred in the city of New Haven. Mr. Lowry has done a large portion of the work of inspecting nursery stock, both that growing in the nurseries of the State and that coming in from foreign countries.

Mr. Zappe was employed during May and June in inspecting pine trees for the white-pine-currant blister rust, under the direction of the State Forester, and for these two months was on the Federal payroll. Under the direction of the Entomologist, he has carried on some detailed studies on the life history, distribution, habits, and food plants of the imported pine sawfly, *Diprion simile*. He has also made the laboratory and insectary records, inspected much nursery stock and has done considerable work on the insect collection.

Miss Foote has done the stenographic and clerical work of the office, which consists of keeping all the records of inspection of apiaries and of imported nursery stock, indexing literature and insect collections, writing letters, typing manuscripts, filing letters and pamphlets, etc. During her vacation and for a short time when she was called home on account of sickness, Miss Alice C. Heath acted as substitute.

Messrs. Coley and Yates have inspected apiaries, as in former years, on a *per diem* basis, their wages and expenses being paid by order of the Comptroller, on duly accredited vouchers, out of an appropriation for the purpose.

All the members of the staff and others mentioned above have worked faithfully and conscientiously, and each deserves credit for whatever degree of success has been reached in the work of the department.

NEW EQUIPMENT.

During the early summer an out-door insectary about 10x16 feet in size was erected near the laboratory. It was built of a wood frame covered with a strong galvanized wire netting having a fine mesh. At first a removable and adjustable canvas roof was constructed, but in the fall this was replaced by a more permanent and stronger roof of boards and shingles. It was feared that the canvas would not carry the weight of snow which sometimes accumulates during the winter. This building is shown on plate 1, a.

A microscope slide cabinet holding 1,500 slides, a No. 4402 micro-Tessar photographic lens, and a second hand No. 3 special Kodak, fitted with Bausch and Lomb No. 11B Tessar lens and compound shutter, have been purchased during the year.

The insect collection has been enriched by a gift of 28 species of beetles of the family Dytiscidæ, from Mr. F. Waldo Dodge of Melrose Highlands, Mass. The specimens are correctly named and neatly mounted, and supplement the other species of this family in the collection.

CHIEF LINES OF WORK.

The routine and control work required by law continue to occupy a major portion of the time and efforts of members of the department staff. This includes the inspection of nurseries, inspection of orchards, gardens, greenhouses, etc., on request, the suppression of gipsy and brown-tail moths, and the inspection of apiaries. Since 1909, when nests of the brown-tail moth were found on stock imported into New York State, we have endeavored to examine all nursery stock entering Connecticut coming from outside the United States, and this inspection has been fairly complete since the establishment of the Federal Horticultural Board with its excellent system of permits and notices, in 1912.

The gipsy and brown-tail moth suppression work has been in immediate charge of Mr. Davis and has required much thought and attention. As provided by law, the work was placed upon a different basis beginning October 1, 1916. All bills are now paid by order of the Comptroller on vouchers which have been receipted and certified, and duly approved by the State Entomologist. The State Entomologist still has general charge of the work, is authorized to make rules and regulations, and must approve all accounts before they can be paid.

Under the new mosquito drainage law, the Director of the Station is authorized to make rules and orders concerning the drainage of swamp lands to eliminate mosquito breeding, and may order any marsh ditched, whenever suitable funds have been raised for the purpose. The Director is also charged with the approval of the work, after which the towns are obliged to maintain it.

As a large drainage project was under way involving all the salt marsh areas in the towns of Madison, Guilford, and the eastern part of Branford, the Director called upon the entomological department to inspect the work and Mr. Walden was

assigned the task. This work required the most of his time from April 1 to September 1. Mr. Walden has also inspected about 32,000 feet of ditches cut in salt marshes in Saybrook and about 15,000 feet in the lower part of the West River marsh in the town of Orange near New Haven.

Experiments in controlling the white pine weevil have been in progress for several years, and during 1916 were continued at Rainbow by Mr. Walden. The study of the imported pine sawfly, *Diprion simile* Hartig, commenced last year, has been continued by Mr. Zappe under the writer's supervision. A number of interesting observations were made on habits and food plants, and some new parasites were reared. This work was carried on in the new out-door insectary.

Experiments in controlling the insects attacking squash, pumpkin, and cucumber, and particularly the striped cucumber beetle and the squash borer, were conducted by Mr. Lowry under the writer's supervision, at the Station farm at Mt. Carmel. One-half acre of ground was devoted to this work and especially with the squash borer the treated rows gave a good crop of squashes, while the untreated rows had many of the vines killed, resulting in a small crop. This work will probably be continued next year.

The Entomologist has kept under observation during the season a scale-insect on silver maple.

The entomological supervision of the Station orchards at Mt. Carmel has been continued, and Messrs. Lowry and Zappe have examined the young apple and peach trees for borers, as in preceding years.

The Entomologist has given considerable time to forthcoming bulletins on insects to be published by the Connecticut Geological and Natural History Survey. Bulletin No. 22, "The Hymenoptera of Connecticut," which is about to be issued, has required reading and correcting of proof. He has also written a portion, and edited the remainder of a series of papers on the "Hemiptera of Connecticut," which will appear as an early bulletin of the Survey.

The following pages give a more detailed account of the work of the department for the year.

INSPECTION OF NURSERIES.

This work was commenced on August 8, and finished October 11, and was done by Messrs. Lowry, Davis, Zappe, Walden, and Britton. Dr. Clinton, Botanist, accompanied the party occasionally and visited a few of the larger nurseries, giving particular attention to the white-pine-currant blister rust, which has been found in two nurseries.

As was the case last year, the Ford car was used to transport the men, especially to the larger nurseries. The car was thus available for about a month, but was needed on the gipsy moth work by Mr. Davis after September 15.

On account of the outbreak of the white-pine-currant blister rust, an inspection of all white-pine plantations, where imported stock was used, was made in May and June by Station men in coöperation with the U. S. Department of Agriculture. This work was in charge of Mr. W. O. Filley, State Forester, but members of the botanical and entomological departments assisted. Some of the larger nurseries had previously imported pines from Europe and these were, therefore, inspected early in the summer. All nurseries were inspected for this as well as other pests in late summer, when the regular annual inspection was made. In August and September this disease was found on currants in a few nurseries and all diseased stock destroyed.

On the whole the nurseries were found to be in unusually good condition, though the inspection was uncommonly rigid. In 37 nurseries no pests were found; in 23 there were traces of San José scale. Oyster-shell scale was noted in 30; scurfy scale, 5; euonymus scale, 2; pine leaf scale, 2; spruce gall louse, 10; white pine weevil, 3; sawfly larvae on pine, 7; chestnut blight, 5; fire blight, 2; black knot, 6; white-pine-currant blister rust, 2; tulip tree scale, West Indian peach scale, *Kermes*, *Lina scripta*, linden borer and leopard moth, 1 each.

In all cases the infested trees or plants were suitably marked and reported to the owner with written orders regarding destruction or treatment. No certificates were issued unless these instructions had been carried out.

Besides the regular inspection and certification of nurseries, six inspection trips have been made, and 19 parcel certificates issued to persons who are not regular nurserymen, but who wish to ship woody plants, and are unable to do so without certificates.

Four nurseries have been inspected twice, in addition to the blister-rust inspection of pines in May and June which included practically all nurseries having pines.

Of the 83 names on the nurserymen's list, 15 are new since the publication of the list for 1915. Three have discontinued the business in Connecticut. The area now devoted to growing nursery stock in Connecticut is 1,526 acres. The list for 1916, together with date and number of certificate and acreage of each, is as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1916.

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate.
Alderson & Dell, The Misses ...	Greenwich	1	Nov. 23,	802
Barnes Bros. Nursery Co.	Yalesville	155	Sept. 27,	749
Beattie, Wm. H.	New Haven	1	Sept. 27,	759
Bowditch, J. H.	Pomfret Center..	4	Sept. 8,	734
Brainard Nursery & Seed Co. ..	Thompsonville ..	6	Sept. 18,	741
Bradley, H. M.	Derby	1	Sept. 27,	758
Bradley, Smith T.	New Haven	1	Sept. 13,	740
Braley & Co., S. A.	Burnside	1	Aug. 28,	729
Bretschneider, A.	Danielson	1	Oct. 2,	771
Brooks Bros.	Westbrook	2	Oct. 11,	790
Burroughs, Thos. E.	Deep River	2	Oct. 16,	795
Burr & Co., C. R.	Manchester	300	Sept. 5,	730
Chapman, C. B.	Groton	1	Oct. 9,	788
Chapman, C. E.	North Stonington	2	Oct. 9,	787
Comstock & Lyon	Norwalk	60	Nov. 9,	800
Conine Nursery Co., The F. E..	Stratford	50	Sept. 29,	763
Conley, L. D.	Ridgefield	3	Oct. 2,	765
Conn. Agricultural College (Prof. A. G. Gulley)	Storrs	2	Oct. 2,	769
Conn. Agri. Experiment Station (W. O. Filley, State Forester)	New Haven	1	Sept. 27,	761
Conway, W. B.	New Haven	1	Sept. 18,	742
Cross Highway Nurseries	Westport	6	Oct. 18,	796
Dallas, Inc., Alexander	Waterbury	3	Sept. 20,	743
Dehn & Bertolf	Greenwich	25	Oct. 6,	781
Dowd, Frank C.	Madison	3	Oct. 4,	777
Elm City Nursery Co., Wood- mont Nurseries, Inc.	Woodmont & New Haven ..	155	Oct. 4,	772
Fairfield Landscape & Nurseries Co.	Cannon Station..	5	Nov. 29,	807
Gardner's Nurseries	Cromwell	10	Aug. 28,	727
Geduldig, G., Estate of	Norwich	1	Oct. 2,	770

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate.
Goodwin Associates, Inc., The				
James L.	Hartford	1	Oct. 11,	792
Hartford Park Commissioners				
(G. A. Parker, Supt.)	Hartford	3	Sept. 27,	752
Heath & Co., H. S.	Manchester	50	Sept. 5,	732
Hilliard, H. J.	Sound View	1	Oct. 11,	791
Holcomb, Irving (2)	Simsbury	1	Oct. 4,	778
Horan & Son, Jas.	Bridgeport	1	Sept. 27,	753
Houston & Sons, J. R.	Mansfield	4	Oct. 4,	776
Hoyt's Sons Co., The Stephen ..	New Canaan	300	Oct. 2,	764
Hubbard & Co., Paul M.	Bristol	12	Oct. 30,	798
Hunt & Co., W. W.	Hartford	12	Oct. 6,	779
Isselee, Charles	Stamford & Greenwich	3	Oct. 4,	774
Kelley, James	New Canaan	1	Sept. 9,	736
Kellner, Herman H.	Danbury	1	Oct. 2,	767
Laurel Park Farm & Nurseries..	Burnside	90	Oct. 6,	782
Long, J. A.	East Haven	1	Sept. 13,	739
Mallett & Co., G. A.	Bridgeport	1	Oct. 9,	785
Maplewood Nursery Co. (T. A. Peabody, Mgr.)	Norwich	1	Oct. 16,	794
Marigold Farm	New Canaan	1	Sept. 11,	737
McDermott, E. F.	Windsor	1	Oct. 4,	773
Meier & Gillette	West Hartford..	2	Sept. 25,	748
Munro, Charles	New Haven	1	Sept. 13,	738
New Haven Nurseries Co.	New Haven	10	Dec. 1,	808
New Haven Park Commissioners				
(G. X. Amrhyn, Supt.)	New Haven	30	Oct. 9,	786
New London Cemetery Ass'n.				
(F. S. Newcomb, Pres.)	New London ...	1	Nov. 27,	804
Northeastern Forestry Co.	Cheshire	20	Sept. 9,	735
Oakland Nurseries	Manchester	50	Sept. 5,	731
Palmer, L. M.	Stamford	5	Oct. 4,	775
Park Gardens	Bridgeport	1	Sept. 27,	762
Pequod Nursery Co. (2)	Meriden	15	Sept. 27,	750
Phelps, J. Wesson	Bolton	1	Nov. 28,	805
Phelps & V. T. Hammer Co., The J. W.	Branford	2	Nov. 28,	806
Pierson, Inc., A. N.	Cromwell	35	Aug. 28,	728
Platt Co., The Frank S.	New Haven	1	Nov. 9,	799
Pomeroy, Edwin C.	Northville	1	Oct. 2,	768
Purington, C. O.	Hartford	1	Oct. 20,	797
Raab, Joseph O.	Ansonia	1	Sept. 27,	755
Reck, Julius	Bridgeport	1	Sept. 27,	757
Roehrich, W. G.	Stratford	1	Sept. 27,	754

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate.
Rowe, Henry C.	Groton	2	Nov. 25,	803
Saxe & Floto	Waterbury	1	Sept. 20,	744
Schleichert, F. C.	Bridgeport	2	Sept. 22,	746
Scott, J. W.	Hartford	5	Jan. 10,	809
Sierman, C. H.	Hartford	3	Sept. 25,	747
South Wilton Nurseries	South Wilton ...	5	Oct. 9,	784
Stamford Seed & Nursery Co. ..	Stamford	1	Oct. 6,	783
Steck, Charles A.	Bethel	2	Oct. 2,	766
Stratfield Nursery Co.	Bridgeport	4	Sept. 27,	756
Traendly & Schenck	Rowayton	2	Oct. 11,	793
Upson, R. E. (2)	Marion	3	Sept. 20,	745
Vidbourne & Co., J.	Hartford	7	Oct. 6,	780
Wallace, Arthur T.	Wallingford	1	Nov. 20,	801
Wallingford Nurseries (2)	Wallingford	10	Sept. 27,	751
Wilson & Co., C. E.	Manchester	7	Sept. 5,	733
Yale University Forest School..	New Haven	2	Sept. 27,	760
Young, Mrs. Nellie A.	Pine Orchard ...	1	Oct. 11,	789
Total		1,526 acres		

INSPECTION OF IMPORTED NURSERY STOCK.

The quantity of woody, field-grown nursery stock entering Connecticut from Europe has not shown a material falling off, as might be expected on account of the war. During the fiscal year just ended, we have inspected 291 shipments, containing 2,102 cases and 1,998,178 plants, as against 264 shipments, 1,349 cases and 2,102,222 plants the preceding year.

The same system of notices and permits arranged by the Federal Horticultural Board as was used last year still remains in force, and seems to be satisfactory. Altogether 300 reports of inspection have been made to the Federal Horticultural Board. During the past year this inspection work has required the equivalent time of one man working 197 days of 7½ hours each or about two-thirds of the working time of an entire year. The cost of this work including time and traveling expenses, has amounted to about \$1,120.00 and has been paid from the appropriation for suppressing gipsy and brown-tail moths and for inspecting imported nursery stock, by the State Comptroller on duly accredited vouchers.

The sources of this stock are about the same as last year, except that none was received from Germany or Italy, and the quantity from Holland shows an increase, and that from Belgium a decrease. These differences are probably more apparent than real, as it is understood that considerable stock is transported from Belgium into Holland and then shipped to America. The figures appear in the following table:

SOURCES OF IMPORTED NURSERY, 1915-1916.

Country	No. of Shipments	No. of Cases.
Holland	154	1,432
Belgium	75	380
France	27	168
England	20	82
Ireland	3	3
Scotland	8	9
Japan	4	28
Total	291	2,102

In addition to the figures given above, notice was received of 12 other shipments containing 42 cases. Of these, two shipments were refused, two consisted of orchids and were examined at the port of entry by Federal inspectors, five contained herbaceous plants, and one, seeds, and these were not inspected. One never reached its destination, and one was retained in New York.

Of the 291 shipments examined, 94, or 32.3 per cent, were found infested with various insects or plant diseases, some of which may be considered pests. Some of the plant diseases were identified by Dr. G. P. Clinton, Botanist of this Station, and others and some of the insects were determined by specialists of the U. S. Department of Agriculture at Washington. These infestations are given in the following list:

INFESTATIONS FOUND, 1915-1916.

Plant Diseases.

Exobasidium on Azalea. (48 shipments.)

M. Debaerdemaeker, Evergem, Belgium (3); J. De Duyssseleyn (5), O. De Vuyst (5), K. J. Kuyk (2), Arthur De Meyer (4), Societe Anonyme Horticole, Mont St. Amand (2), Ghent, Belgium; Bier & Ankersmit (6), De Coster Bros. (2), Melle, Belgium; August Toeffer (4), Alphonse Colle, Destelbergen, Belgium; Haerens Co. (August Haerens) (2), Somergem, Belgium; De Bruyne Bros. (3),

L. Ch. Vander Linden Bros., P. T. Vander Sypt, Loochristy, Belgium; De Bruycker & B. Driesbeke, Wyncket St. Croix, Belgium (2); De Bruycke & L. Driesbeke, Gand, Belgium; Van Dillewyn & Thiel, Meirelbeke, Belgium (4).

Crown gall.

On rose. King's Acre Nurseries, Hereford, England; Vincent Lebreton's Nursery, La Pyramide-Trelaze, France; Levavasseur & Fils, Ussy, France.

Phyllosticta sp. on Rhododendron.

Schaum & Van Tol, Boskoop, Holland.

Phyllosticta aucubicola Sacc. on Aucuba.

D. Nieuwenhuis & Zonen, Lisse, Holland.

Fungus on Palm.

P. T. Vander Sypt, Loochristy, Belgium.

Sterile mycelium of fungus.

Ant. Roogen & Son, Hagerswoude, Holland.

Ascomycete, Immature, on apple.

Franco-American Seedling Co., Angers, France.

Sclerotinia stage of *Botrytis* on Golden Privet.

W. Fromow & Sons, Windlesham, Surrey, England.

Pestalozzia guepini on Rhododendron. (3 shipments.)

Schaum & Van Tol (2), H. den Ouden & Son, Boskoop, Holland.

Insects.

Oyster Shell Scale. On *Buxus*.

Ebbinge & Van Groos, Boskoop, Holland (3); J. Blaauw & Co., Schaum & Van Tol, K. Rosbergen & Son, L. D. Endtz & Co., W. Van Kleef & Son., Jac. Akerboom & Sons, H. M. Hardyzer, D. Nieuwenhuis & Zonen, Lisse, Holland; Verkade Van Kleef, Waddinxveen, Holland.

Diaspine Scale.

On Palms. Societe Anonyme Horticole de Mont St. Amand, Ghent, Belgium.

On Aspidistras. K. J. Kuyk, Ghent, Belgium; Bier & Ankersmit, Melle, Belgium.

On Bay Trees. Aug. Toeffer, Destelbergen, Belgium.

Scale on Rose stock. L. Renault, Orleans, France.

Chionaspis salicis Linn. (egg stage) Green Ash cross stick. W. Fromow & Sons, Windlesham, England.

Coccus hesperidum. Societe Anonyme Horticole de Mont St. Amand, Ghent, Belgium.

Pseudonidia paeoniae Ckll. Rhododendron. Yokohama Nursery Co., Ltd., Yokohama, Japan.

Emphytus cinctus on Manetti stock. Franco-American Seedling Co., Angers, France; Hemeray-Aubert, Orleans, France.

On (?). G. Bernard (or Benard), Olivet, France; Levavasseur & Fils, Ussy, France.

Larvae on Manetti stock. Levavasseur & Fils, Ussy, France.

Capsid. On Myrobolan plums. Doorne Bosch & Zoon, Veenham, Holland.
 Psyllids on *Buxus*. Schaum & Van Tol, Boskoop, Holland; Jac. Akerboom & Sons, Boskoop, Holland.

Agelastica alni Linn. (3).

H. den Ouden & Son, Van Gelderen & Co., Schaum & Van Tol, Boskoop, Holland.

Aleyrodes on Azalea. Van Dillewyn & Thiel, Meirelbeke, Belgium (2); Aug. Haerens, Somergem, Belgium.

Woolly Aphis. Roots of Spruce Trees. Franco-American Seedling Co. Apple. Franco-American Seedling Co., Angers, France.

Rhodites sp. gall. *Rosa rubiginosa*. G. Bernard, Orleans, France.

Cynipid gall on oak. Union Nurseries, Oudenbosch, Holland.

Coccinellid beetle. Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

2 Staphylinid beetles. Jac. Smits & Co., Naarden, Holland.

Tussock moth egg mass. On Maple. Ebbinge & Van Gross, Boskoop, Holland (2). Union Nurseries, Oudenbosch, Holland.

On (?) Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

Dead Lepidoptera. Arthur De Meyer, Mont St. Amand, Ghent, Belgium.

Lepidopterous cocoon. On Evergreen. Koster & Co., Boskoop, Holland.

On (?). Vincent Lebreton's Nursery, La Pyramide-Trelaze, France; De Bruyne Bros., Loochristy, Belgium; 2 parasitized. Ebbinge & Van Groos, Boskoop, Holland.

Lepidopterous larva, probably Pyralid. On Azalea. Van Dillewyn & Thiel, Meirelbeke, Belgium.

Empty cocoon and larval skin of Gipsy Moth. On Apple. Franco-American Seedling Co., Angers, France.

Dipterous pupa. On Rhododendron. C. Van Kleef & Co., Boskoop, Holland.

Coleopterous larva. On Rhododendron. C. Van Kleef & Co., Boskoop, Holland.

Empty Sawfly cocoon. Levavasseur & Fils, Ussy, France; De Bruyne Bros., Loochristy, Belgium.

Sawfly larvae and pupae. Vincent Lebreton's Nursery, La Pyramide-Trelaze, France.

Work of borers in roots of oak. Louis Leroy's Nursery Co., Angers, France.

Spider's eggs on *Buxus*. Ebbinge & Van Gross, Boskoop, Holland.

Centipede in packing material. Schaum & Van Tol, Boskoop, Holland.

INSPECTION OF APIARIES.

The total number of apiaries inspected in 1916 is 467, as against 494 for the preceding year. The cost per apiary and per colony averaged slightly more than in 1915. As in former years Mr. H. W. Coley of Westport has made the inspections in

Fairfield, New Haven, Middlesex, and New London counties, and Mr. A. W. Yates of Hartford has covered Litchfield, Hartford, Tolland, and Windham counties.

Some inspections were made in each county, but, of course, not in each town. In all 96 towns, as against 90 last year, were visited by the inspectors, and apiaries were examined in each town. This is a larger number than has even been visited before in a single season since the advent of apiary inspection in Connecticut in 1909. Of this number the towns of Ashford, Ansonia, Bethany, Brookfield, Brooklyn, Canaan, East Haddam, Greenwich, Guilford, Hampton, Huntington, Kent, Mansfield, Monroe, New Milford, Newtown, North Haven, Norfolk, Orange, Plainfield, Prospect, Salem, Salisbury, Scotland, Sharon, Simsbury, Southbury, Southington, Stafford, Suffield, Tolland, Willington, Windham, Wolcott, and Woodbridge were not covered in the work last year, and apiaries in the towns of Ansonia, Ashford, Bethany, Brookfield, Canaan, Guilford, Kent, Monroe, New Milford, Orange, Plainfield, Salem, Salisbury, Simsbury, Tolland, Wolcott, and Woodbridge have never before been officially inspected. In Fairfield county 117 apiaries were inspected, in Hartford county 98, and in New Haven county 71. In each of Fairfield and New Haven counties, 21 towns were visited by the inspector, and in Hartford county 18 towns.

Foul brood was found in all the counties of the State, European foul brood occurring in seven towns in Fairfield county, 10 towns in New Haven county, two towns in Middlesex county, seven towns in New London county, four towns in Litchfield county, five towns in Hartford county, six towns in Tolland County, and six towns in Windham county. Both European and American foul brood were found in one town in New London county, one town in Middlesex county, and in three towns in Fairfield county. The percentage of diseased apiaries and colonies is somewhat less than last year for European foul brood, but slightly greater for American foul brood.

The statistics regarding the apiaries inspected in each town in each county are given in the following tables, the summary appearing on page 82.

APIARIES INSPECTED, 1916.

	No. Apiaries			No. Colonies	
	Inspected	Diseased*	Quarantined	Inspected	Diseased*
FAIRFIELD COUNTY.					
Bethel	18	2	0	54	2
Bridgeport	1	0	0	58	0
Brookfield	4	0	0	32	0
Danbury	13	0	0	141	0
Darien	2	0	0	56	0
Easton	2	0	0	83	0
Fairfield	9	0	0	94	0
Greenwich	4	0	0	60	0
Huntington	1	1†	0	7	5†
Monroe	5	2	0	81	3
New Canaan	6	0	0	28	0
Newtown	4	3†	1	60	8†
Norwalk	4	0	0	33	0
Redding	5	0	0	34	0
Ridgefield	5	3†	0	64	7†
Stamford	5	3§	0	51	8††
Stratford	2	0	0	45	0
Trumbull	3	0	0	69	0
Weston	3	0	0	20	0
Westport	6	0	0	66	0
Wilton	15	1	0	197	2
	117	15	1	1,333	35
NEW HAVEN COUNTY.					
Ansonia	2	1	0	15	2
Beacon Falls	1	0	0	4	0
Bethany	1	0	0	5	0
Cheshire	6	0	0	76	0
Derby	6	0	0	74	0
Guilford	2	1	0	9	3
Hamden	2	0	0	9	0
Madison	1	1	0	29	1
Meriden	12	2	1	129	4
Middlebury	2	1	0	43	35
Milford	3	0	0	26	0
Naugatuck	4	1	1	37	12
New Haven	3	1	0	8	2
North Haven	2	0	0	79	0
Orange	1	0	0	1	0
Prospect	9	1	0	88	8
Seymour	2	0	0	16	0
Southbury	4	1	0	12	1
Waterbury	5	0	0	37	0
Wolcott	1	1	1	18	18
Woodbridge	2	0	0	3	0
	71	11	3	718	86

INSPECTION OF APIARIES.

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	No. Apiaries			No. Colonies	
	Inspected	Diseased*	Quarantined	Inspected	Diseased*
MIDDLESEX COUNTY.					
Chatham	7	3†	0	67	7†
East Haddam	9	4	0	83	6
	16	7	0	150	13
NEW LONDON COUNTY.					
Bozrah	2	2	0	10	3
Lisbon	1	1	0	4	1
Montville	10	6	0	36	9
New London	1	1	0	10	2
Norwich	3	0	0	133	0
Old Lyme	2	1†	0	52	3**
Salem	6	5	0	13	10
Waterford	3	1	0	59	2
	28	17	0	317	30
LITCHFIELD COUNTY.					
Canaan	10	1	0	67	3
Harwinton	1	0	0	1	0
Kent	5	1	0	40	1
New Milford	3	0	0	3	0
Norfolk	3	1	0	9	2
Salisbury	6	0	0	27	0
Sharon	8	0	0	30	0
Torrington	11	6	0	58	7
	47	9	0	235	13
HARTFORD COUNTY.					
Berlin	6	0	0	66	0
Bloomfield	9	5	1	133	11
Bristol	2	2	0	6	4
East Hartford	1	0	0	3	0
East Windsor	4	0	0	14	0
Enfield	5	0	0	9	0
Farmington	3	0	0	35	0
Glastonbury	15	1	0	67	4
Hartford	11	0	0	61	0
Manchester	1	0	0	4	0
Plainville	4	3	0	14	7
Simsbury	3	0	0	10	0
Southington	6	0	0	54	0
South Windsor	2	0	0	31	0
Suffield	9	0	0	27	0
West Hartford	11	1	0	65	3
Windsor	1	0	0	4	0
Windsor Locks	5	0	0	28	0
	98	12	1	631	29

	No. Apiaries			No. Colonies	
	Inspected	Diseased*	Quarantined	Inspected	Diseased*
TOLLAND COUNTY.					
Andover	3	1	0	9	6
Bolton	4	0	0	7	0
Coventry	11	3	0	88	27
Ellington	2	0	0	12	0
Mansfield	5	1	0	62	4
Stafford	2	1	0	18	1
Tolland	2	1	0	18	1
Vernon	8	0	0	74	0
Willington	11	6	0	49	22
	48	13	0	337	61
WINDHAM COUNTY.					
Ashford	1	0	0	10	0
Brooklyn	3	1†	0	27	1††
Hampton	3	2‡	0	10	4††
Killingly	7	1	0	20	2
Plainfield	4	1	0	15	1
Pomfret	8	1	0	34	1
Putnam	9	1	0	22	2
Scotland	4	0	0	25	0
Windham	3	2	0	14	11
	42	9	0	177	22

SUMMARY OF APIARY INSPECTION.

County	No. Towns	No. Apiaries		No. Colonies	
		Inspected	Diseased	Inspected	Diseased
Fairfield	21	117	15	1,333	35
New Haven	21	71	11	718	86
Middlesex	2	16	7	150	13
New London	8	28	17	317	30
Litchfield	8	47	9	235	13
Hartford	18	98	12	631	29
Tolland	9	48	13	337	61
Windham	9	42	9	177	22
	96	467	93	3,898	289

* European foul brood unless otherwise indicated.

† An apiary with both American and European foul brood.

‡ One apiary infested with sacbrood.

§ Two apiaries with disease of adult bees.

|| One apiary killed by European foul brood.

¶ One colony has American foul brood.

** Two colonies with American foul brood.

†† Six colonies with disease of adult bees.

‡‡ One colony with sacbrood.

	Apiaries	Colonies
Number inspected	467	3,898
Infested European foul brood	88	275
Per cent infested	18.8	7.05
Infested American foul brood	5	6
Per cent infested	1.07	.15
Pickled or sacbrood	2	2
Average number of colonies per apiary		8.34
Cost of inspection		\$750.34
Average cost per apiary		1.61
Average cost per colony		.19

X CONTROLLING THE GIPSY AND BROWN-TAIL MOTHS.*

By W. E. BRITTON and IRVING W. DAVIS.

Notwithstanding the fact that the law provides that towns shall, when ordered by and under the direction of, the State Entomologist, suppress the gipsy and brown-tail moths, it was thought best, for the present at least, to keep the gipsy moth work in the hands of trained men. It would be very difficult, if not impossible, for the several towns to secure trained and experienced men for this work, and consequently the results which they might accomplish would not be of maximum effectiveness. Plans to this effect were, therefore, prepared, and these plans, together with the more important purchases of supplies and equipment, have been duly approved by the Station Board of Control, as provided in Section 3, Chapter 267, Public Acts of 1915. The following pages give a brief account of the work accomplished under the act.

GIpsy Moth Work.

AREA INFESTED AND CHARACTER OF INFESTATIONS.

At the beginning of the fiscal year 20 towns were thought to be infested by the gipsy moth, but during the winter Ashford was found infested by the Federal scouts, making 21 in all. These towns have a total area of about 730 square miles and are as follows:

* This paper was included in the report, which the law requires the State Entomologist to make to the General Assembly. It is here given with slight emendations.

Thompson	Brooklyn	Voluntown
Putnam	Hampton	Griswold
Pomfret	Chaplin	Sprague
Woodstock	Sterling	Lisbon
Eastford	Plainfield	North Stonington
Ashford	Canterbury	Stonington
Killingly	Scotland	Groton

Since the manuscript of this paper was prepared, the Federal scouts have found an infestation in Mansfield near the eastern boundary. As Mansfield contains 46 square miles, the total infested area must now be regarded as 776 square miles.

All of these towns are shown on the accompanying map, figure 1.

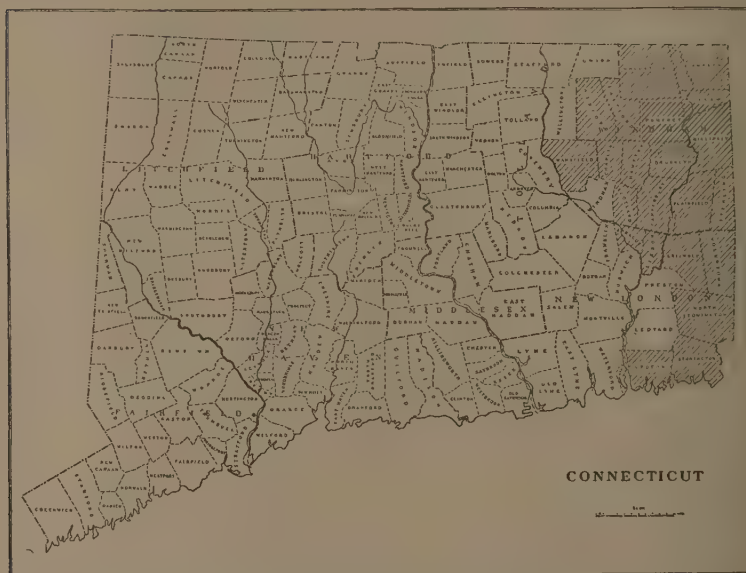


FIG. 1. Map of Connecticut, shaded portion showing area now infested by the gipsy moth.

The worst infested towns are Thompson, Putnam, Woodstock, and Pomfret, having an area of about 172 square miles. The number of infestations in each of these towns was found to be somewhat less than during the preceding year, as the following table will show:

Town	Number of Infestations	
	1915	1916
Thompson	166	100
Putnam	24	21
Woodstock	40	21
Pomfret	22	27
Total	252	169

Mr. Davis employed scouts from about November 1 to May 1, and during this time they searched the towns of Thompson, Putnam, Woodstock, Pomfret, Killingly, and Brooklyn, and destroyed all egg clusters found. All other towns were searched by the Federal scouts. No gipsy moths were found in the towns of Sterling, Voluntown, Sprague, and Lisbon, and none were found in Killingly by State or Federal scouts, though one caterpillar was reported by Mr. Woodward from East Killingly, near the Rhode Island line. Fewer infestations were also found in Hampton, Griswold, and Groton, though more were found in Eastford, Scotland, Canterbury, Chaplin, Stonington, and North Stonington. The same number occurred in Brooklyn and Plainfield, and the additional town of Ashford was found by the Federal scouts to be slightly infested in four places.

ORGANIZATION.

Irving W. Davis, B.Sc., a graduate of the Massachusetts Agricultural College, class of 1911, was already in charge of this work at the time the law was enacted, and on my recommendation, he was formally appointed Assistant and Deputy in Charge of Moth Work by the Board of Control of the Connecticut Agricultural Experiment Station, as provided in Section 3 of the act. Throughout the year Mr. Davis has resided in Danielson, where he may be reached by telephone, 28-3, or by mail. He has also employed men for the necessary work of scouting, cutting brush, spraying, applying tanglefoot, and examining the sticky bands. Trained scouts have been paid the same wages as is paid by the Federal Bureau of Entomology for this work, viz., from \$2.56 to \$3.20 per day, the latter being paid only to foremen who have had much experience. As our appropriations have never been adequate to cover the entire work, we have been obliged to depend on the coöperation of the Bureau of Entomology, and it frequently happens that both State and Federal men may be

employed in the same vicinity, or perhaps board at the same place. Consequently it seemed desirable to make hours and wages correspond as nearly as possible.

Untrained men have been employed temporarily for cutting brush and handling hose for \$2.00 per day.

In general the men are not allowed their expenses, except in special cases where moved from one town to another or where sent on trips involving an actual outlay.

The number of men employed has varied from 8 to 25 as the exigencies of the work required.

COÖPERATION WITH FEDERAL AGENTS.

From the start there has been the most cordial coöperation between the Federal and State forces seeking to control these dangerous insect pests. As a rule, each year the territory has been divided, each covering a portion and being responsible for it. As a Federal problem, perhaps the most important phase of this work is to prevent the further spread of the gipsy moth to other states; hence many towns not known to be infested have been examined by Federal men. On the other hand it seemed to us a better use of State funds to expend them in eradicating known infestations, rather than in hunting for new ones. Consequently during the year just closed, the Federal men have scouted the outside towns or those on the border of the infestations, while the State forces have endeavored to suppress the pest in the area most thickly infested. Even the Federal scouts have often been placed under the general supervision of Mr. Davis, and have reported all infestations to him. Likewise he has reported to the Federal agents all infestations found by the State scouts. Our thanks are due to Messrs. A. F. Burgess, L. H. Worthley, and other members of the Bureau of Entomology for this coöperation.

EQUIPMENT.

No extensive equipment has been added during the fiscal year, but free use has been made of the power sprayer, the Ford touring car, and the motor cycle and bicycles purchased during the preceding year. Four sets of tools and four tool boxes were purchased for the scouting crews at a total cost of \$85.38.

SUPPLIES.

For spraying the trees in and around the principal infestations, two tons of arsenate of lead were purchased at a cost of \$295.76, and for banding the trees in and around the infestations, one ton of tanglefoot was purchased at a cost of \$375.00. A portion of each kind of material was not used and is available for the coming season.

METHODS OF SCOUTING FOR EGG-CLUSTERS.

Since the gipsy moth passes the winter in the egg stage, locating and destroying the egg-clusters has proven one of the best methods of controlling this pest.

The scouting for these egg-clusters, as it has been carried on in Connecticut, is commonly known as "roadside scouting." By this is meant the examination of all trees outside of woodland, and in wooded areas to examine or "scout" the trees for a distance of from 50-200 feet from the clearing, the distance depending on the species of trees and type of growth. Recent work by the United States Department of Agriculture has shown that this insect is spread principally by means of wind, and, therefore, it is necessary to scout carefully all windswept areas, paying particular attention to the apple and oak trees, which are the favorite food of the gipsy moth.

The organization has consisted of from one to four crews, each group or crew having at least four men and a foreman. The men or "scouts," as they are termed, are each equipped with a small mirror and a knife, the end of the blade of which is curved. The former is used to examine the under side of rocks, cavities in old trees, etc., while the latter is used to pull off pieces of dead bark, and for the man to mark his tree. Each man is given a special mark when he begins work, and it is equivalent to his writing his name on each tree that he examines. For example:—Scout J. J. Fitzgerald while scouting in the town of Killingly uses the mark —L, and all trees in that town which bear that mark show that he has examined them and is, therefore, responsible for them. Should any egg-clusters of the moth be found on that tree later, the man who examined it could be ascertained immediately. The foreman of the crew is not allowed to mark a tree until after a scout has done so, and

when the foreman's mark appears it places the responsibility on him. This also has the additional advantage of keeping the foreman behind his men so that he can follow their work better.

Besides the equipment that each man carries, each crew is required to have with it at all times, a can of creosote, a can of white paint, and a small hatchet. Each crew has a box of tools which is left at the boarding-house. This box contains axes, saws, etc., to be used in chopping out around the infestations.

The men are required to work eight hours a day. They leave their boarding-house at 7 o'clock and their time begins at 7.30. The working period is from 7.30 to 12.00 and from 12.30 to 4.00, after which they walk home in their own time. In the case of stormy or inclement weather, the men chop or burn brush around the infested localities, but if the day proves too stormy they are allowed to return to the boarding house, but are subject to the foreman's call up to 3 o'clock in the afternoon.

In order to make the work as simple and as efficient as possible, blue-print maps are made of the roads in each town, and each road is lettered, the main roads being lettered as A, B, C, D, etc., while the side roads are designated according to their location as A1, A4, B14, C9, etc. One of these maps is given to the foreman, and on this he designates the infestations found; another copy is filed in the office of the State Entomologist at New Haven, and a third is retained by the deputy.

Gummed paper arrows are used to enable anyone familiar with the work to find the crews. The foreman leaves one of these in front of the boarding-house each morning, with the arrow pointing in the direction that the crew is working. On this arrow is written the date, time the arrow was placed there, where the crew will work that day, and the foreman's initials. One of these arrows is also placed at each crossroad that is passed, and bears a legend similar to the first.

Reports are made by the foreman twice each week, and contain the name of the town being scouted, the date, the foreman's name, the name of the road worked, the number of miles scouted each day, the miles of wooded growth, the time lost and the reason, the number of trees examined (apple and shade), and if any infestations are found, the owner of the land, his address, the location of the infestation and the number of egg-clusters.

When the work has been completed in a town a similar report is sent in, which covers all of the infestations in that town.

APPLYING AND INSPECTING BANDS.

During the first part of May the trees in and about the infested localities are scraped so as to smooth the bark, but not enough to injure the cambium or inner bark, and the tree is banded with a sticky substance known as "tree tangle-foot." This prevents the gipsy moth caterpillars from crawling up the trees, and as these localities are visited every day or so during the caterpillar season, the young caterpillars may be easily destroyed. The caterpillar season lasts from the middle of May until the middle or last of July.

When the infestations are plentiful, the men are able to use bicycles in the work, but in the outlying districts where the infestations are far apart, motorcycles have been used in visiting them.

SPRAYING.

In case any of the infestations assume a serious nature, we try to spray them during the month of June. At this time the caterpillars are rather small and it does not require as much poison to kill them, and the leaves have grown enough to have plenty of surface to hold the poison. The mixture used is arsenate of lead, 6 pounds in 50 gallons of water. The spraying is accomplished by the use of a Fitzhenry-Guptill power sprayer. This has a 10-12 horse-power gasoline engine, and a 400 gallon tank to hold the mixture. In spraying these localities, 1,500 feet of hose is used, and in the running of the sprayer a crew of about four men besides the engineer and nozzleman are required. This past season this machine was used to spray 60 of the worst infestations in the State.

DETAILS OF GIPSY MOTH WORK BY TOWNS.

The details of the infestations and of the suppression work in each town have been prepared by Mr. Davis, and are described briefly in the following pages:

Thompson—100 infestations—1,359 egg-clusters.

Thompson, covering an area of 49 square miles, and situated as it is on the border of Rhode Island and Massachusetts, has

always been the most seriously infested of any of the Connecticut towns, and this past year has proved no exception.

The number of infestations (100) showed a decrease from the previous year when 166 were located. These infestations, however, were well distributed throughout the entire town, although a large number were situated in the vicinity of the road leading from Brandy Hill to Webster, Mass. In this group was located the largest infestation found during last winter, numbering 398 egg-clusters. Large infestations were also found near the village of Grosvenordale, on the State road about a mile south of Wilsonville, and on the road from Brandy Hill to the Quaddick reservoir.

During the early part of the summer work, several of these infestations showed a large number of larvae, and 39 of the most serious infestations were sprayed. The work closed on the 22d of July, but this town with the rest of the infested area will be thoroughly scouted this coming winter.

Woodstock—21 infestations—127 egg-clusters.

The finding of only 21 infestations in the town of Woodstock during the winter of 1915-16, reduced the number of colonies almost half from the previous year when 40 were located.

The majority of the infestations found were in the vicinity of the villages of East Woodstock and West Woodstock, with scattering ones in various parts of the town. One infestation, which was found about a mile and a half south of West Woodstock, was perhaps the worst one in the town this season. Here several large larvae were found outside of the banded area, but by doing extra scouting in that locality the number was greatly diminished before the end of the season.

None of the gipsy moth colonies in Woodstock were sprayed, as they were not deemed serious enough to warrant it, and on July 22d the work of patrolling the banded area closed for the season.

Putnam—21 infestations—141 egg-clusters.

The gipsy moth infestations in the town of Putnam numbered 21, and while 10 of these contained only a single egg-cluster each, there were several comparatively large ones. The largest in the town was one of 52 egg-clusters, which was located near

the Woodstock line on land owned by Mr. Henry Maynard. Early in the season a number of larvae were found here feeding on small oak growth, and this infestation together with 8 others in the town was sprayed.

Among other infestations of importance in Putnam, were those located on the State road about two miles east of the city of Putnam, one in the south part near the grounds of the Putnam Country Club, and one on a cross-road a mile to the east of the city. This last mentioned infestation was located on a roadside apple-tree, and during the early part of June a large number of gipsy moth caterpillars were found feeding on low brush on the opposite side of the road. This brush was cut and burned, and the remaining foliage on either side of the road was sprayed. The last few visits to this infestation failed to reveal any larvae, and it is believed that this infestation together with the others in this town have been exterminated.

Pomfret—27 infestations—686 egg-clusters.

The first part of the scouting done in Pomfret last winter was in the eastern section of the town, and as there were but few infestations located, it was believed that this town was comparatively free from the pest. As the work was carried to the western portion of the town, however, a number of infestations were located on a thickly wooded ridge which extends north and south along the western border of Pomfret.

Here the most serious infestation in the State was found, consisting of 304 egg-clusters and covering approximately ten acres of woodland. This growth was thinned and the remaining trees banded with tanglefoot, and the entire area sprayed. During the woodland scouting in August this section was again covered, and 20 egg-clusters found. (See plate II, b.)

Just previous to the spraying work a number of egg-clusters and larvae were found close to an infestation in the northern part of the town near the Putnam and Woodstock lines. This was thoroughly sprayed, and by the end of the season we were unable to find any more larvae in this vicinity.

Eastford—5 infestations—93 egg-clusters.

Of the five infestations found in Eastford, four were located in the eastern part of the town near the Pomfret line, while the

fifth, a pupa case, was found on the road leading from Phoenixville to Ashford.

The work of patrolling the infestations was carried on here as in the other infested towns, but none of the colonies in this town assumed serious nature.

Ashford—49 infestations—20 egg-clusters.

The scouting during the winter of 1915-16 found the town of Ashford infested by the gipsy moth for the first time. Four infestations were located, the largest consisting of 12 egg-clusters and situated about two miles south of the village of Warrenville.

During the summer work only eight gipsy moth caterpillars were found in this town. (See plate II, a.)

Killingly—0 infestations—0 egg-clusters.

Although this town has been infested for the past two years, a thorough scouting, and later a careful trailing, failed to reveal any egg-clusters of the gipsy moth.

Toward the latter part of the caterpillar season it was reported that a gipsy moth caterpillar had been taken in East Killingly near the Rhode Island line, but an examination of the nearby trees failed to show any evidence of the pest.

Brooklyn—2 infestations—13 egg-clusters.

The two infestations found in the town of Brooklyn were widely separated, one being in the southwestern corner, and the other in the northeastern corner of the town. At the former no larvae were found, but at the latter several appeared early in the season and this infestation was sprayed. No caterpillars were found after the middle of July, and at the time the summer work closed this infestation appeared free from the pest.

Hampton—6 infestations—151 egg-clusters.

Six infestations of the gipsy moth were found in the town of Hampton during the last winter, and all of them were grouped in the northwestern corner of the town. The largest of these contained 127 egg-clusters, and was located in an old orchard owned by Mr. Fowler. This infestation assumed a serious nature early in the season, and that together with the neighboring growth was sprayed with arsenate of lead.

The other infestations, while showing a number of caterpillars in the early part of the work, were apparently free from the pest before the season closed.

Chaplin—2 infestations—16 egg-clusters.

During the scouting in the town of Chaplin two colonies of gipsy moths were found within its limits. Both of these were in the eastern part of the town near the Hampton line, and contained 4 and 12 egg-clusters respectively. The latter was on the State road just below Clark's Corner. Here a few caterpillars were taken early in the summer, but nothing was found the latter part of the season.

Sterling—0 infestations—0 egg-clusters.

During the winter of 1915-16 this town was thoroughly scouted, but no signs of the gipsy moth were found.

Plainfield—1 infestation—160 egg-clusters.

The only gipsy moth infestation found in the town of Plainfield during last winter was located in the western part of the town near the Quinebaug River. This numbered approximately 160 egg-clusters, and while a large proportion of these were found in the trunk of a large apple tree, there were several scattered in the nearby undergrowth. During the month of June a number of larvae were taken here, but none were found during the later visits to this infestation.

Canterbury—10 infestations—211 egg-clusters.

Though six of the 10 infestations in the town of Canterbury were of but a single egg-cluster each, two rather large colonies were located. One of these was situated on the land of Mr. Charles Hyde near the road leading from Brooklyn to Canterbury, and the other a little to the west of the village of Westminster on land owned by Mr. Davis. The former contained 80, and the latter 115 egg-clusters.

These two infestations were the most serious in Canterbury, and in each case the underbrush was cut and the trees pruned. As several larvae were taken early in the season and none later, it is believed that both of these colonies were exterminated before the summer work finished.

Scotland—4 infestations—24 egg-clusters.

Of the four infestations located in the town last winter, one found in the woods close to the Hampton line was the largest. This consisted of 18 egg-clusters and was the only colony in the town where any larvae were taken during the summer. Thirteen caterpillars were taken early in the season, but during the later visits none were found.

Voluntown—0 infestations—0 egg-clusters.

No egg-clusters were found in this town during the past winter's scouting.

Griswold—2 infestations—6 egg-clusters.

There were two gipsy moth colonies found in this town during the winter scouting of 1915-16. One of these colonies consisted of one egg-cluster and was found near the banks of the Quinebaug River, while the other, a colony of five egg-clusters, was located in the southeastern corner of the town near the Preston line. Several larvae were found at the latter infestation early in the season, but during the last few weeks of the work none were taken, and it is hoped that both of these colonies have been exterminated.

Lisbon—0 infestations—0 egg-clusters.

The town was scouted last winter, but no evidence of the gipsy moth was found.

Sprague—0 infestations—0 egg-clusters.

No signs of the gipsy moth were found in Sprague during the past winter.

North Stonington—2 infestations—71 egg-clusters.

Two infestations were found in this town, one a pupa case and the other a colony of 71 egg-clusters. The latter was located in an orchard about a mile to the west of the North Stonington post office. This infestation was rather serious and was not sprayed, owing to the need of the sprayer in the northern towns. Extra scouting work was done in this locality, and when the season closed over 900 caterpillars had been destroyed.

Stonington—2 infestations—55 egg-clusters.

Only two colonies of gipsy moths were found in Stonington during the scouting of 1915-16. One of these was found near Wequetequock and the other in Pawcatuck near the city of Westerly, R. I. Neither of these colonies showed many larvae during the summer work, and during the later visits none were found.

Groton—I infestation—I egg-cluster.

The result of the scouting in the town of Groton during last winter was the finding of a small egg-cluster on Pearl Street in the village of Mystic. This infestation was watched during the summer, but no larvae were found.

STATISTICS OF INFESTATIONS.

The statistics of the infestations for each town are given in the following table:

Town	No. of Infestations	No. Egg-clusters Destroyed	No. of Bands Applied	No. of Infestations Sprayed	No. of Larvae Destroyed
Thompson	100	1,359	5,665	39	11,906
Woodstock	21	127	615	0	562
Putnam	21	141	1,243	9	7,007
Pomfret	27	686	3,749	10	5,700
Eastford	5	93	371	0	42
Ashford	4	20	264	0	8
Killingly	0	0	0	0	1*
Brooklyn	2	13	43	1	65
Hampton	6	151	129	1	4,176
Chaplin	2	16	49	0	42
Sterling	0	0	0	0	0
Plainfield	1	160	17	0	785
Canterbury	10	211	501	0	135
Scotland	4	25	289	0	130
Voluntown	0	0	0	0	0
Griswold	2	6	113	0	53
Lisbon	0	0	0	0	0
Sprague	0	0	0	0	0
North Stonington..	2	71	63	0	989
Stonington	2	55	38	0	70
Groton	1	1	16	0	0
Totals	210	3,135	13,165†	60	31,671

* Reported to the office by Mr. Woodward of East Killingly.

† In addition to this number of bands, 349 bands of *Raupeleim* were used in Thompson and Stonington.

Apple trees examined by State scouts during the winter 1915-16:

Thompson	38,277
Woodstock	53,583
Putnam	14,861
Pomfret	49,256
Killingly	22,960
Brooklyn	26,642
Total	<u>205,579</u>

Shade trees examined by State scouts during the winter 1915-16 (Shade trees counted are only those which stand within 100 feet of a building. No record was kept of roadside trees examined):

Thompson	8,290
Woodstock	9,356
Putnam	4,429
Pomfret	9,702
Killingly	5,481
Brooklyn	5,014
Total	<u>42,272</u>

Total expended by the State in gipsy moth work for the year ending September 30, 1916, \$11,491.42.

BROWN-TAIL MOTH WORK.

The last two years ending September 30, 1915, saw such an increase of the gipsy moth in Connecticut, that it seemed best to use the most of our available funds in the control of this serious pest. The brown-tail moth work done during this period had, therefore, not been in the eastern towns of the State, which were known to be infested with this pest.

Upon examination of this section last fall it was deemed advisable to have the four towns in the northeastern corner of the State, namely,—Thompson, Woodstock, Putnam, and Pomfret, take measures to destroy this pest within their respective limits, as provided by law. Accordingly Mr. J. H. Osgood of Putnam, who has had much experience in this particular line of work, was appointed agent in each of these towns and whenever possible trained local men to help him in the work. Through this same means these four towns were scouted and the following

table shows the number of webs destroyed and the amount expended:

Town	Webs destroyed	Cost	Reimbursed by State
Thompson	1,652	\$ 72.51	\$ 36.25
Woodstock	7,518	212.50	106.25
Putnam	3,008	81.00	41.50
Pomfret	2,272	91.00	45.50
Total	14,450	\$457.01	\$229.50

During the month of March when there were several heavy snow storms, the gipsy moth crews were located in Killingly, and on days when they were unable to scout, they spent their time in destroying brown-tail webs. Through this means about 1,650 webs were cut and burned, the most of them being taken in the town of Killingly, although some 500 were found in the town of Brooklyn.

It has been our custom to have a few trained men scout the towns just west of those known to be infested with this pest and under the Federal quarantine, and during last winter Mr. John H. Osgood took charge of these men. No new towns were found to be infested, and a decrease was noted in those towns near the border, a few of which Mr. Osgood examined for the purpose of determining the spread of parasites. The cost of this work of scouting along the border of the quarantined area was \$186.61. The total cost to the State for brown-tail work was \$416.11.

PRESENT APPROPRIATION.

Out of the biennial appropriation of \$21,000.00 for suppressing gipsy and brown-tail moths, and inspecting imported nursery stock, we have expended \$13,026.20 distributed about as follows:

Gipsy moth work	\$11,491.42
Brown-tail moth work, including 50 per cent rebate to towns of \$229.50	416.11
Inspecting imported nursery stock	1,119.67
	\$13,027.20

This leaves only \$7,972.80 for the coming year.

FEDERAL EXPENDITURES IN CONNECTICUT.

In addition to the total amounts expended by the State, Federal agents in hearty coöperation with us have expended nearly \$15,000.00 in gipsy moth work during the year just closed.

STATE APPROPRIATION FOR NEXT BIENNIAL PERIOD.

It will be seen from the foregoing that during the past year about \$28,000.00 has been expended in this work in Connecticut by the State and Federal Government. In case large additional infestations should be discovered, our funds would be wholly inadequate; consequently, we have asked for an appropriation of \$60,000.00 for this purpose for the two fiscal years ending September 30, 1919.

FUTURE WORK AND RECOMMENDATIONS.

In future moth work it will be necessary to employ more crews and to start trailing. By "trailers" we mean the men who examine the towns and check the work of the scouting crews. These are very important, as they furnish the main office with data of the exact results accomplished by each crew. I would also recommend the purchase of more spraying equipment, because our present outfit is inadequate and will not enable us to spray many infestations in the short time when spraying can be done. More bicycles are also needed; though we have purchased some bicycles, the majority that we use have been borrowed from the Federal Government. More motor vehicles will soon be needed. Judging from our experience with motorcycles, apparently Ford automobiles are about as cheap to operate and can be used on the work throughout the winter. If the infestations increase to any alarming extent, it will probably be advisable to establish a parasite laboratory within the State. This could be maintained in conjunction with the Federal work, and the cost would be insignificant in comparison with the results obtained, as parasites help control both the gipsy moth and the brown-tail moth.

A DESTRUCTIVE APHID ON TURNIPS.

Aphis pseudobrassicæ Davis.

On September 19, Mr. A. N. Farnham telephoned to the Station regarding serious injury to his turnips and kale by aphids, and requested an inspection. In company with Mr. Farnham I visited the farm that day, and saw several fields where damage had been done. One of these fields, which is situated just west or north-west of Pine Rock, contained two or three acres of turnips. A

portion (perhaps a half acre) had been planted to white egg turnips and the plants had been killed. These plants were of good size but had at first turned yellow, then brown, and now they were entirely dead and lay flat upon the ground. This had all happened within a few days, and the plants went down very quickly after the presence of the aphids was noticed. The other portion of the field was covered with rutabagas or Swedish turnips, which were attacked and injured though not as yet killed. There were patches here and there where the leaves were turning yellow. Plate V, a shows the edge of the field, and where the rows of white egg turnips had been killed. In another field south of Pine Rock eight rows of white egg turnips were rapidly being destroyed by the aphids, though at this time the leaves were still green and turning yellow. When visited October 2 the plants were nearly all dead. Swedish turnips on either side of the egg turnips had not as yet been greatly injured, though infested.

We also examined a newly-set field of kale on the top of the hill along Osborn Avenue. The plants were already infested.

IDENTITY.

Considerable material was gathered and taken to the laboratory. Some of the leaves were photographed and are shown on plate IV, b. Some of the aphids were mounted on slides, and were identified as the turnip aphis, *Aphis pseudobrassica* Davis, a species described in 1914, by Mr. John J. Davis of the Bureau of Entomology. In order to verify the identification, some of the slides were sent to Dr. Edith M. Patch, of Orono, Me., who reported that the determination was correct for most of the specimens, but that on two of the slides, another species, the green peach aphis, *Myzus persicae* Sulzer, was present. After this we examined much material and mounted a good series of specimens, and can state with certainty that the turnip aphis was by far the most abundant, and was evidently the one chiefly responsible for the damage.

DISTRIBUTION.

Apparently this aphis was widely destructive in 1916, as complaints were received from A. N. Farnham and W. L. Mitchell, New Haven; Charles M. Jarvis, Berlin, and D. L. Clarke &

Sons, Milford. Mr. Huber, vegetable grower, also reports considerable damage around East Hartford, and at Green's Farms. We examined specimens, however, only from Mr. Farnham's field, though we understood that the insect was destructive throughout Highwood. Presumably the same species is also responsible for the injury elsewhere.

DISTRIBUTION IN OTHER STATES.

According to Paddock*, the turnip aphid has been recorded from New York, Indiana, Minnesota, Oklahoma, Louisiana, Florida, and Texas, and probably occurs throughout the United States. In general it has probably been mistaken for *Aphis brassicæ*, as it feeds upon the same kind of plants.

LIFE HISTORY.

No life history studies of the turnip aphid have been made in Connecticut and most of the observations on record are from Texas. It is not known where the aphids pass the entire season, but they appeared on the turnips in August and September and were found there until the following May. In the spring the infestations are heavy in Texas and continue until the crops are harvested or otherwise disposed of.

The species reproduces asexually in Texas where 19 generations were recorded between January and the following August. The sexual forms are unknown.

DESCRIPTION.

The original description† of the turnip aphid is as follows:

*"Wingless viviparous female:—*Entire body pale whitish green, head slightly dusky. Abdomen with a longitudinal row of impressed dots along each side in line with the cornicles; also on each side of the median dorsal line is a row of transverse shining areas with a reticulated surface, those on the last four or five segments usually united; and a similar row of smaller areas on each side. These shining reticulated areas contrast with the rest of the body which is dull and very slightly pulverulent. Thoracic segments with similar transverse areas. In specimens just molted the entire body appears shining and reticulated.

* Bull. 180, Texas Agricultural Experiment Station, 1915.

† Canadian Entomologist, Vol. xlv, page 232, 1914.

"Eyes black. Antennae blackish excepting segments I, II, and basal half of III which are pale; reaching a little beyond the middle of the body; segment III longest, it being half to three-fourths longer than VI filament; segments V and VI base with the usual distal sensoria. Beak reaching to coxae of second pair of legs. Legs pale with dusky joints, the tips of the tibiae and all of the tarsi black. Cornicles pale with the tip dusky, slightly swollen towards the tip and constricted just before the apex, and noticeably longer than the cornicles of *A. brassicae*. Cauda conical, and dusky to blackish.

"Measurements, as follows (averages from six individuals): Length of body 1.66 mm.; width 1.00 mm.; cornicle 0.226 mm.; cauda 0.140 mm.; antenna I, 0.080; II, 0.061; III, 0.399; IV, 0.202; V, 0.160; VI, base 0.122; VI, filament 0.287; total average length 1.311 mm.



FIG. 2. The turnip aphid, *Aphis pseudobrassicae*, winged female, greatly enlarged.

"Pupa. Head dusky, remainder of body cream color or with a faint greenish tint, and covered with a slight whitish pulverulence, excepting the shining areas which are covered with a noticeable reticulation, and which are placed as follows:—a row of oval or transverse areas on each side of the median dorsal line and a row of smaller and more circular ones laterad of these on each side, about in line with the cornicles.

"Eyes black. Antennae pale dusky, the distal ends of segments being more so, relative lengths of segments as in the winged female. Wing pads blackish. Legs pale dusky with the joints, distal end of tibiae, and tarsi blackish. Cornicles dusky, paler at middle, blackish at tips, and similar in shape to those of the wingless female.

"*Winged viviparous female*.—Head and thorax black. Abdomen pale apple green with a tint of Nile green and a row of three black spots on each side anterior to the cornicles; a row of small impressed dots on

each side dorsad of the larger spots; and in addition a few scattered inconspicuous dusky markings on the dorsum, and the last three segments with black transverse, dorsal median markings.

"Eyes black. Antennae black; almost reaching to base of cornicles; segments III and VI filament subequal; segment III with 19 to 26 moderately tuberculate circular sensoria irregularly placed, IV with 6 to 10, often more or less in a row, V and VI base with the usual distal sensoria and not infrequently segment V bears one or two near the base. Wings with black and rather conspicuous veins, and the terminal branch of the media nearer the apex of wing than where it first branches. Legs with femur pale brownish to blackish, tibia pale brownish with tip black and tarsus black. Cornicles dusky, paler at tips, and shaped as in the wingless form. Cauda concolorous with the abdomen or paler. Measurements as follows (averages from six individuals): Length of body 1.4 mm.; width of body 0.66 mm.; length of wing 2.4 mm.; width of wing 0.9 mm.; antenna I, 0.069; II, 0.061; III, 0.363; IV, 0.191; V, 0.165; VI, base 0.126; VI, filament 0.358; total average length 1.333 mm.; length of cornicle 0.172 mm.; of cauda 0.134 mm."

HOST PLANTS.

This aphid is found upon turnip, raddish, cabbage, cauliflower, kale, rape, kohl-rabi, collard, rutabaga, mustard, lettuce, and bean in Texas. Paddock* states that there is a period of four or five months when it is not found upon these cultivated host plants. This suggests an alternate host, but the plants are not known.

In Mr. Farnham's field aphids were found on the weeds and upon horseradish plants growing near the turnips. Their presence in such cases, however, may have been accidental or on account of their great abundance, and does not necessarily mean that these plants are real hosts.

INJURY TO CROPS.

The injury is due to the large number of aphids sucking out the sap. When the infestation is severe, the leaves turn yellow and later brown, and soon wither and die. In regions of extensive areas devoted to truck crops, especially cruciferous plants, serious damage may result.

At Mr. Farnham's the infested turnips and kale were entirely killed. As there were many other fields in the same locality and nearly all similarly affected, it must have caused thousands of dollars of damage in the State in 1916.

* Bull. 180, Texas Agricultural Experiment Station, 1915.

NATURAL CHECKS.

In Mr. Farnham's three fields, two of which were perhaps half a mile apart, lady beetles were abundant in both the larval and adult stages and many pupae were fastened to the under sides of the leaves. The commonest species observed were the nine-spotted lady beetle, *Coccinella ix-notata* Hbst., and the five-spotted lady beetle, *Coccinella transversoguttata* Fabr. (*V-notata*). Many leaves were found which were entirely cleaned of the aphids by the lady beetles, though there were plenty of cast skins showing that aphids had been present and abundant. In Texas *Aphis pseudobrassicæ* is strongly parasitized by two Hymenopterous parasites, *Dieretus rapæ* Curt. and *Lysiphlebus testaceipes* Cress. These were not observed by us in connection with this aphid in Connecticut in 1916.

When examining this aphid material in the laboratory, it was noticed that a few individuals had been killed by a fungous disease. These were shown to Dr. G. P. Clinton, Botanist of the Station, and at his request sent to Dr. A. T. Speare of the Bureau of Entomology at Washington, who is at work on this group of fungi. Dr. Speare identified it as *Entomophthora aphidis* Hoff.

On October 2, this fungus was far more noticeable than on the previous visit and the under surface of the leaves was covered with aphids which had been killed by it, and giving the leaf a brownish color. Many of the wingless aphids showed a pinkish color, which, as Dr. Clinton pointed out, is an indication that they are infected. He examined several and found mycelium in their bodies. These fungous-killed aphids are shown on plate V, b.

These natural checks did not combine to save the crops at Mr. Farnham's in 1916, bright as the outlook appeared for them to do so. They were too late. Conditions for their rapid multiplication were favorable only after the aphids had increased to such an extent that the plants had died from their attacks.

REMEDIES.

At the start it seemed doubtful if artificial remedies could be employed to advantage in control of this pest, particularly after the whole field became infested. Mr. Huber suggested that

where colonies first started here and there in a field, straw be burned over the infested plants in order to kill the aphids and prevent their further spread.

In Texas many tests were conducted to control this aphid by spraying and by fumigating. One of the most successful was spraying the under leaf surface by means of an elbow tube and nozzle, using common laundry soap, 1 lb. in 7 gals. of water. Even though this treatment could not be applied to the whole field, it might well be employed to kill the first colonies as they appear in spots over the field.

LITERATURE.

Davis, John J., Canadian Entomologist, Vol. xlv, page 231, 1914 (original description, with figures).

Paddock, F. B., Texas Agricultural Experiment Station, Bull. 180, 1915 (full account).

THE CONTROL OF APHIDS IN FIELDS OF SEED BEETS.

In the Report of this Station for 1915, page 191, is a brief account of damage in Milford to fields of seed beets owned by the Everett B. Clark Seed Company. Three species, *Aphis rumicis* Linn., *Macrosiphum solanifolii* Ashm., and *Myzus persicae* Sulz., were present on the plants as well as on lambs' quarters and pigweed growing about the field, though the first species, being much the most abundant, was probably responsible for most of the damage.

On June 20, 1916, the writer visited the fields of the Clark Seed Company with Mr. F. E. Rogers, of the New Haven County Farm Bureau. At this time the brown species, *A. rumicis*, had just commenced to form colonies around the succulent stem and leaves near the tops of the taller plants, especially around the margins of the field. Only a few individuals were present in each colony and the plants had not yet been injured. We examined several fields, none of which were exempt, as small colonies were detected here and there, usually occurring on the upper portion of the tallest stalks and being more numerous around the edges of the field.

Mr. Clark was advised to send a careful man through the fields with a small knapsack spray outfit and to spray thoroughly that portion of each plant seen to be infested. "Black Leaf 40," one teaspoonful in a gallon of water with a little soap added, was the material used. A second visit was made in company with Mr. Rogers, July 11. We saw innumerable places where the spray had hit the aphid colonies and there were many dead aphids on the stalks and leaves. On the whole the treatment had been effective. A few living aphids were found here and there, and Mr. Clark promised to go over the fields again, and it surely would pay to do it. At this time there was promise of a heavy crop of beet seed, and by checking the aphids so as to protect the plants for another month, the crop would be sufficiently mature to be safe from injury.

This treatment is far less expensive than to spray all the plants in the field, even with a power outfit, and by taking it in season the aphids can be controlled by killing them when the colonies are small though conspicuous and before they spread to all the plants. The writer believes this to be an important point in the treatment of other kinds of aphids also, though some crops do not lend themselves so well to it as does the beet seed crop.

THE WHITE-MARKED TUSSOCK MOTH.

Hemerocampa leucostigma, S. & A.

From time to time serious damage is done to shade trees in the larger towns and cities on account of the attacks of the white-marked tussock moth, the larvae of which feed upon the leaves. Thus, in various times outbreaks have occurred in Washington, Baltimore, Philadelphia, New York, Albany, New Haven, Providence, Boston, and probably in many other cities. This insect is usually a greater pest in towns and cities than in the open country, yet in 1908* it caused serious damage in the apple orchards of western New York, one grower estimating his loss as high as 25 per cent of the total value of the crop. It has been taken repeatedly in Connecticut on both orchard

* Bulletin No. 312, New York (Geneva) Agricultural Experiment Station, 1909.

and shade trees. In 1905* it was abundant in New Haven and Hartford and defoliated many shade trees including elm, chestnut, horse chestnut, and poplar, and again in 1916 it was noticeable in many towns of the State. In Albany and Troy, N. Y., more than thirty years ago Dr. Lintner observed a different form of injury by the caterpillars of this insect. They ate the tender bark of new shoots of the elm, thus girdling them and causing them to break off and drop to the ground. In a paper read in 1895 Dr. Lintner† states that this girdling has been observed each year since 1883.



FIG. 3. White-marked tussock moth. a, larva: b, female pupa: c, male pupa: d, e, male moth: f, female moth: g, female laying eggs: h, egg-mass i, k, cocoons—all slightly enlarged. (After Howard, Bur. Ent., U. S. Dept. Agr.)

* Report Conn. Agr. Expt. Station, page 230, 1905.

† Report, New York State Entomologist, II, page 124, 1895.

During the season just closed, the white-marked tussock moth has been received at the Station 17 times, including three times from points in New York State. In most cases it was reported from shade trees, but in one instance the caterpillars were feeding on peach and in another on quince.

In September specimens were sent us from New London with a request for an inspection, as it was feared that the gipsy moth was present there. Consequently Mr. Davis visited New London on September 22, and found the insect in question to be the white-marked tussock moth, which was abundant there.

The egg-clusters are conspicuous on the trunks and larger branches of trees during the winter months, where they appear as white foamy masses, characteristically shown on plates VI, and VII, a and c.

LIFE HISTORY AND HABITS.

Along the coast and up the river valleys and in fact over most of the area of Connecticut, there are two generations each year of the white-marked tussock moth. Felt* reports that only one generation occurs normally in Albany, and there are at least three annual broods in the vicinity of Washington, D. C.

The insect passes the winter in the egg stage. These eggs hatch in May in Connecticut, and the young caterpillars feed upon the under side of the leaves eating at first only the green portion and leaving the veins and upper epidermis. As the caterpillars increase in size, they eat holes entirely through the leaves, and when nearly full grown are voracious feeders and devour the whole leaf except perhaps the largest veins. The larval or caterpillar stage lasts about five weeks, during which time the caterpillars molt or cast their skins five times. When nearly mature the caterpillars have the habit of crawling considerable distances, and are able to go over the ground from one tree to another. If numerous, they migrate from the defoliated trees, and may be seen crawling over fences, sidewalks, or upon vehicles, and in this way they spread to other trees.

It is usually about the first week in July in Connecticut when the mature larva transforms. It spins some silken threads and with them mixes some of the long hairs from its own body,

* Insects Affecting Park and Woodland Trees, Vol. 1, page 135, 1905.

forming a gray cocoon, which is usually placed on the rough bark of the trunk or larger branches, though sometimes on the small twigs or leaves, and on buildings, fences, and monuments. The insect remains in the cocoon about two weeks. The male on emerging flies about and is attracted to lights. The female, having no wings, cannot fly, and though she may crawl short distances, usually deposits her cluster of eggs on the old cocoon. The egg-mass is pure white, of a frothy texture, and contains from 100 to 500 eggs. It is shown on plate VII, a. The eggs laid in July soon hatch and the caterpillars feed through August and into September, when they become full grown and pupate. In 1905, the adults emerged from many of these cocoons. Normally the winter is passed in the egg state, though Packard, quoting Riley,* states that occasionally a living pupa may be found in the winter.

FOOD PLANTS.

The white-marked tussock moth has a long *menu*, including nearly all kinds of fruit trees, most of the forest and shade trees except conifers, as well as many common shrubs. Among the shade trees, poplar, elm, horse chestnut, linden, and soft maple seem to be preferred.

DISTRIBUTION.

The white-marked tussock moth is found from Florida to Nova Scotia and as far west as Nebraska. It is probably the most abundant in southern New England and the Middle Atlantic States.

DESCRIPTION.

The caterpillars are distinguished by the four yellow or white brush-like tufts of hair standing upright in a row on the back. A broad black band extends longitudinally along the back, bordered by yellowish subdorsal stripes. Laterally the caterpillar is dark gray with yellow tubercles. Head bright red. There are two long pencils or plumes of black hairs projecting forward over the head and one similar plume extending backward at the tail. This is one of the most striking and beautiful caterpillars found in Connecticut, and may often be seen crawling on the

* Fifth Report, U. S. Entomological Commission, page 264, 1890.

sidewalk, trunks of trees, fences, etc. When fully grown the caterpillar is about one and three-fourths inches long, and its general appearance is shown on plate VII, d.

The female is about five-eighths of an inch long, gray, and wingless, and resembles the female canker worm only larger. The male has a wing-spread of about one and one-fourth inches and is dull gray with rather inconspicuous marking on the fore wings, with slender body, and large and feathery antennae as shown on plate VII, b. The cocoons are dark gray or slate-color, and about three-fourths of an inch long.

The egg-masses are usually about one-half inch in diameter though irregular in shape and size. They are usually laid upon the old cocoon and are pure white and very conspicuous.

PARASITES AND NATURAL CHECKS.

It is known that certain species of birds feed upon the caterpillars, especially in their younger stages. Unfortunately native birds are not sufficiently abundant in cities to hold the moth in check. The robin, the Baltimore oriole, the yellow-billed cuckoo, the whip-poor-will, the phoebe, the chimney swift, the blue jay, and the English sparrow have been observed feeding upon the caterpillars. Several insect parasites have been recorded. In New York State in 1908, the ichneumon flies (*Pimpla*) *Scambus inquisitoriellus* Dalla Torre (= *inquisitor*) and (*P.*) *S. conquisitor* Say, were abundant, the former being the more numerous. These two species infested about 95 per cent. of all the parasitized cocoons in the vicinity of Geneva and Lockport. Around Geneva about 60 per cent of all cocoons were parasitized, and in some orchards around Lockport the parasitism reached 80 per cent.

Dr. L. O. Howard* states that in Washington in 1895 about 90 per cent of the larvae were killed by parasites. Of these *Scambus inquisitoriellus* D. T. (*Pimpla inquisitor* Say) and *Chalcis ovata* Say were the most effective. He also records the following as primary parasites of the white-marked tussock moth: *Scambus marginatus* Provancher, (*Pimpla annulipes* Say) *Amorphota orgyia* How, *Meteorus communis* Cress., *M. hyphantriae*

* Technical Series, No. 5, Division of Entomology, U. S. Department of Agriculture, 1897.

Riley, *Limneria valida* Cress., *Limneria* sp., *Theronia fulvescens* Brullé., *Apanteles delicatus* How., *A. hyphantriæ* Riley, *A. parorgyiæ* Ashm., *Pteromalus cuproideus* How., *Cratotechus orgyiæ* Fitch, and *Telenomus orgyiæ* Fitch. In addition to these primary parasites Howard lists a large number of hyperparasites which often counteract the good done by the primary parasites in checking the white-marked tussock moth. Several two-winged or dipterous parasites have been reared from the cocoons, as follows:—*Frontina aletiae* Riley, *F. frenchii* Williston, *Tachina mella* Walker, *T. clisiocampæ* Townsend, *Euphorocera claripennis* Macquart, *Exorista griseomicans* Van der Wulp, *Winthemia quadripustulata* Fabricius, *Sisyropa* sp.

CONTROL MEASURES:

There are two chief methods of controlling this insect: (1) by poisoning the foliage, and (2) by destroying the egg-clusters.

Spraying. A thorough spraying of the foliage in June will destroy the larvae of the first brood. Lead arsenate (3 lbs. of the paste in 50 gallons of water) is probably the best poison for this purpose. As it adheres well to the foliage it may not be necessary to repeat the application, unless the second brood caterpillars are very abundant and migrate from adjacent unsprayed trees. In such cases they will be able to find sustenance on foliage which has formed subsequent to the application of the poison, and a second spraying in August may be advisable.

Destroying the Egg-clusters. The destruction of the eggs is often the most economical method of destroying the pest, and this can be accomplished in two ways; (1) by scraping off and burning the egg-masses, or (2) by treating them on the tree with something that will prevent their hatching. The former method is practiced in New York and some other large cities, where men employed for the purpose become very expert in the use of a specially made tool, consisting of a small hoe blade mounted on the end of a long pole. By means of this tool many of the egg-clusters can be reached from the ground and dislodged. But if left upon the ground and not destroyed, these eggs will hatch. Hence they should be gathered and burned or saturated with creosote to prevent hatching.

A simpler method is to soak the egg-masses *in situ* with crude creosote by means of a brush or sponge mounted on a long pole. This can be dipped in the creosote and pressed against the egg-masses. As the creosote discolours the pure white eggs, it is easy to distinguish the treated from the untreated eggs. This creosote has long been used to kill gipsy moth eggs and is effective if a sufficient amount of the liquid is used to thoroughly soak through the mass. Otherwise some of the eggs may survive.

It should be borne in mind that the treated and discoloured egg-clusters will remain for a time on the bark, and render the trees more or less unsightly. In case of choice shade trees near the home, it may be advisable to remove them, just for the sake of appearance.

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X

THE ROSE CHAFER.

Macrodactylus subspinosus Fabr.

For many years this insect has caused much damage to growing fruit and garden crops in Connecticut, and it was particularly troublesome in 1916.

In the Report of this Station for 1905, page 259, is a brief note regarding damage to young peach fruits by rose chafers and the injury is shown on plate XII, b, of the same Report. Aside from a mere mention this is the only place in the reports

of the State Entomologist where any information is given regarding the rose chafer. A brief account of its injury, life history, and the control methods to be used against it is given here for the information of the many orchard and garden owners who suffer from its ravages throughout the State.

It is generally considered that the rose chafer is a much more serious pest on sandy soils, for it breeds chiefly on such soils. The soil is sufficiently sandy in Connecticut for it to be present in destructive numbers all over the State, but it is especially abundant along the coast.

DISTRIBUTION.

The rose chafer occurs from Canada southward to Virginia and Tennessee and as far west as Colorado and Oklahoma. The region of its greatest abundance and, therefore, of its greatest destructiveness, is in Southern New England and the Middle Atlantic States. Though it has been reported as especially destructive in certain sections of Maryland, Virginia, West Virginia, Pennsylvania, New York, Ohio, Indiana, Illinois, Nebraska, Kansas, Michigan, Vermont, Massachusetts, and Rhode Island, it is not uniformly destructive throughout these states, and does little damage on the larger areas where the soil is a heavy clay. As has already been stated, the insect breeds in sandy soils and may be expected to cause its greatest devastation over sandy areas.

INJURY CAUSED BY THE ROSE CHAFER.

Injury to Plants. Grapevines were injured by the rose chafer as early as 1810, and always have been a favorite food of the beetles, which emerge in this latitude just before the middle of June and begin their attack at the blossoming time of the grapes. They eat away the blossoms and newly set fruit, often entirely destroying the crop. They also feed upon the leaves, riddling them and sometimes almost defoliating the vines.

Though grape vines have long been a preferred food, the rose chafer is by no means confined to them, but attacks all kinds of trees and shrubs. Fruit trees are often seriously damaged, and the work of the adult beetles is common on shade trees. Plate IX, d, shows some small peaches which have been eaten by the

beetles. The writer recalls that in 1906, in Stonington nearly all of the native vegetation was attacked and many of the cultivated trees and shrubs had their leaves riddled. Even the greenbrier, *Smilax* sp. was defoliated. In fact when these beetles are exceptionally abundant, almost all forms of vegetation are attacked and devoured. Plate VIII, b, shows the characteristic injury on a birch leaf.

One of the most disgusting forms of injury caused by the rose chafer is that which this insect inflicts upon choice flowers, such as roses, paeonies, and late blooming iris in the garden. Plate VIII, a, shows the chafers feeding upon a rose. White roses and white paeonies are especially sought by the beetles, which eat holes in the petals, and soil the flowers so that they are worthless. They also attack pink and other light-tinted varieties, but seldom molest the dark ones. As the light-colored flowers are usually the most effective in the ornamental garden, they cannot well be eliminated in favor of the dark colors. The beetles are usually on hand in time to attack roses and paeonies.

Injury to Chickens. It is not wholly as a pest of plants that we must consider the rose chafer an injurious insect. It has often been stated that chickens would die soon after eating the beetles. This was first called to the writer's attention by Professor G. H. Lamson, Jr., of the Connecticut Agricultural College at Storrs, who has recently published a short account of his investigations.* From 15-20 rose chafers are enough to kill a week-old chicken that eats them. It takes from 25-45 rose chafers to kill a chicken three weeks old. Mature fowls and chickens ten weeks old and upwards are seldom killed. An extract was made from rose chafers and this, when injected into rabbits, killed them in a few minutes. These results lead Professor Lamson to believe that rose chafers contain a neuro toxin which affects the heart action of both chickens and rabbits, and renders them a dangerous food for young chickens. Chickens, therefore, should be kept in a mowed field away from grapes, flowering shrubs, or herbaceous plants during rose chafer time and especially when rose chafers are abundant.

* Journal of Economic Entomology, Vol. 8, page 547, 1915.

LIFE HISTORY.

The beetles emerge from the ground and attack plants usually about June 10-12 in New Haven. The earliest record in the Station collection is June 9. Of course, this date varies somewhat each year according to climatic conditions, yet it is fairly constant for a given locality. I well remember hearing a fruit grower state that the beetles had not failed for many years to appear on June 12 at his place in North Windham. The beetles are usually feeding for about four weeks, and are present for about six weeks, though diminishing in numbers toward the end of this period, then they disappear entirely. There is only one generation or brood each year. Soon after emerging the beetles mate, and they are usually found in pairs on the foliage. The female lays her eggs singly, a few inches below the surface of the ground, usually depositing from 24 to 36 eggs. The eggs soon hatch and the young larvae feed upon the succulent roots of grass and other plants, becoming full grown by late autumn when they descend deeper into the ground below the frost line. The following spring in April or May they ascend, transform to pupae in earthen cells, and from two to four weeks later the beetles dig their way out into the open air and attack the plants. The adult lives, on the average, about three weeks.

DESCRIPTION.

The adult beetle is yellowish-brown with head, thorax, and body together about one-third of an inch long, and with long sprawling legs. There is usually a greenish tint on the thorax and the legs are deep honey-yellow with black spines. The beetle is shown on plate IX, c.

The larva is yellowish-white with pale brown head. The egg is smooth, oval, about 1.5 mm. in length, white, and semitransparent. Two eggs as laid in the soil are shown on plate IX, b, about two and one-half times enlarged.

CONTROL MEASURES.

The rose chafer is an exceedingly difficult insect to control by ordinary measures, and though many practices have been advised, most of them have proved unsatisfactory when the beetles are present in large numbers.

Spraying with Arsenical Poisons. Grapes in the vineyard should be sprayed heavily and thoroughly just before the blossoms appear and again after the blossoms fall, using lead arsenate (paste) 5 lbs. in 50 gallons of water. This spray may also be applied to the foliage of any shade trees or ornamental shrubs around the place, and also to fruit trees unless the fruit is nearly ready to harvest. Even when covered with this poison, the leaves and fruit will often be somewhat injured, because the beetles are obliged to do considerable feeding before they obtain enough poison to kill them.

Covering with Bags or Netting. The newly-set clusters of grapes are often enclosed in a paper or cloth bag which is pinned tightly around the stem. This will protect the fruit from being injured by the rose chafer as well as several other insect pests, and is a practice that may well be adopted on a small scale, as in the home garden. It is hardly practicable in the vineyard. Likewise choice shrubs and small trees may be protected by covering them with mosquito netting to keep away the beetles.

Hand Picking. When the beetles are on flowers, like roses, paeonies, etc., which cannot well be protected, hand picking is about the only remedy. A good way to destroy them is to drop them into a tin can containing kerosene.

Cultivation. It has been found that the pupa is easily destroyed, while the larvae and adults are hard to kill. This suggests plowing and harrowing the ground, or deep cultivation, at the time the insect is in the pupa stage, say during the last week in May.

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EXPERIMENTS IN CONTROLLING THE STRIPED CUCUMBER BEETLE AND THE SQUASH BORER.

By W. E. BRITTON and QUINCY S. LOWRY.

At the Station farm, Mt. Carmel, in 1916, one-half acre of ground was assigned to this department for use in field experiments in the control of certain insects attacking cucurbits. Chief among these insects are the striped cucumber beetle, *Diabrotica vittata* Fabr., and the squash borer, *Melittia satyriniformis* Hübn., though observations were made on the squash bug, *Anasa tristis* Degeer, and some other species. All plants were grown from seed planted May 25. The following varieties were grown: Cucumbers—Davis Perfect, White Spine, and Long Green; Squashes—Fordhook, Delicata, Boston Marrow, Hubbard; Pumpkin—Small Sugar. These tests do not show satisfactory results, and we expect to continue them. Nevertheless, they indicate certain possible lines of treatment, and the uselessness of others, so we mention them here.

STRIPED CUCUMBER BEETLE.

Striped beetles were more abundant than the writers have ever seen elsewhere. They attacked both cucumbers and squashes before they appeared above ground and nearly all plants were ruined, notwithstanding the various treatments applied. Consequently it was necessary on June 23 and 24 to replant the whole field. The plants in some of the rows were covered with protectors as shown on plate I, b, and if applied early enough, these protectors will probably prove as effective as any treatment. In most cases, however, beetles were already at work on the stems of the plants below the surface of the ground before the protectors were placed over the plants. Probably there were also some beetles that emerged from the ground under each frame. Undoubtedly these protectors will keep off the beetles which fly to the field.

In using arsenical poisons, the dry or powdered form seemed to be rather more effective than the same amount of poison applied as a spray.

We hope to continue this work next season, and will test the protectors placed over the hills when the seeds are planted.

SQUASH BORER.

After the attack of the striped beetle had subsided, there were enough squash and pumpkin plants left for a fair crop, except for the injury caused by the squash borer. Few adults were noticed on the field, yet when the plants were carefully examined on August 1, several were found to be infested with young borers. It was intended that plants of each variety be given the same treatment, but through some oversight this was not done. We have, therefore, no good basis for comparing yields, yet it was certain that more plants were saved where the young borers were cut out than was the case with the check plants, or where only the vines were covered with soil.

Rows 21-26 were examined closely for borers. Their presence is indicated by the "sawdust" thrown out of the stem. With a small sharp knife, a longitudinal incision was made in the stem and the larva killed by cutting with the knife. If taken in season the vines are not much injured and the wound soon heals.

The first cutting out was done August 4, though the two rows of pumpkins were not examined until August 7, when 45 borers were found in row 25, and 55 in row 26.

On August 16, the check rows had lost a greater number of plants than the adjoining rows, where the vines were covered with soil, but finally did not give any better yield. The best results were obtained where the borers were cut out.

The following table shows the varieties, treatment, and also the yield based upon a count of the mature squashes and pumpkins October 11:

RESULTS OF TREATMENT ON SQUASHES AND PUMPKINS.

Variety	No. of Row	Yield	Treatment
Boston Marrow	{ 17	13 squashes	} Check. No treatment.
	{ 18	15 "	
	{ 19	5 "	} Vines covered with soil.
	{ 20	9 "	
Hubbard ...	{ 21	58 "	} Borers cut out.
	{ 22	45 "	
	{ 23	44 "	
	{ 24	59 "	
Small Sugar	{ 25	96 pumpkins	
	{ 26	54 "	

It is planned to continue the trials, using different treatments of the same variety the coming year. Probably the greatest benefit will follow the combined treatments of cutting out the borers and covering the vines with soil.

OUTBREAK OF THE EIGHT-SPOTTED FORESTER.

Alypia octomaculata Fabr.

Order *Lepidoptera*, Family *ZYGAENIDAE*.

By QUINCY S. LOWRY.

During the past summer the eight-spotted forester occurred in large numbers in the neighborhood of Howard Avenue, New Haven. Though present each year, it seldom attracts attention, and there are no records, at least since the office of State Entomologist was established in 1901, which indicate that the eight-spotted forester has been anything like as abundant in Connecticut as during this outbreak.

The writer was sent to the home of Mr. E. A. Prince at 498 Howard Avenue, New Haven, to investigate a complaint made by him that his grape arbors and Virginia creepers were being rapidly defoliated by "worms." At this date, July 22, 1916, the Virginia creepers were entirely stripped (see place X, a) and the grape arbors nearly so; even the young clusters of fruit were badly eaten by the caterpillars, which were present by the thousands. These proved to be the larvae of the eight-spotted forester, *Alypia octomaculata* Fabr.

Mr. Prince was advised to spray at once with arsenate of lead all the foliage remaining on his premises. This was done, and when the arbors were inspected again on July 28, it was difficult to find any living larvae to collect for rearing purposes in the laboratory. However, there were quantities present in adjoining yards.

Only brief accounts of this insect have been recently published, and these do not figure this insect as being of any economic importance. If the eight-spotted forester should appear in abundance in commercial vineyards a great amount of damage would be caused, considering the number of caterpillars in this outbreak in the city yards of New Haven.

LOCALITY INFESTED.

The locality infested was within the radius of a mile from the junction of Howard and Kimberly Avenues, where any grape vines or Virginia creepers were present, and great numbers of these caterpillars were found to be completely destroying the foliage by the twenty-eighth of July. There is no doubt that this pest is very local in its habits, as it did not appear in any other section of the city, neither was it reported from any of the commercial vineyards of the State.

FOOD PLANTS.

These caterpillars cause the greatest amount of damage to the grape, both the wild and cultivated varieties. However, the Virginia creeper, *Ampelopsis quinquefolia* Michx., is another favorite food plant, and the common barberry, *Berberis vulgaris* Linn., and varieties of rose were found to be readily eaten by these larvae on the estate of Mr. Prince, which may have been due to the fact that the foliage of the grape and Virginia creeper at this date had been nearly destroyed, and they were forced to feed on what foliage remained.

In 1891 an article was published by C. V. Riley* who says; "*Alypia octomaculata* is one of the most troublesome caterpillars; the great abundance of *Ampelopsis* vines in the parks and especially around it covering 'squatter sovereignty' houses, affords congenial food for its rapid propagation. In the parks the vines are twice annually treated with a solution of London purple applied with a spraying machine. This has proved most effective, and the vines do not seem to be injured as easily as most plants by the arsenates."

DISTRIBUTION.

Morris† reports that the eight-spotted forester is common in the northern states, while Dr. John B. Smith‡ lists it as being common through the eastern and central United States. Saunders§ states that it is very generally found throughout the United States and Canada, while Dyar|| gives its distribution as being

* Insect Life, Vol. iv, p. 61.

† Morris, Lepidoptera of North America, page 132, 1860.

‡ Smith, Economic Entomology, page 263, 1896.

§ Saunders, Insects Injurious to Fruits, page 262, 1900.

|| Dyar's List of North American Lepidoptera, page 97, 1902.

the Atlantic States. The station collection shows that adults were collected from New Haven, Stonington, and Watertown, Connecticut, also from Savoy, Massachusetts, a majority of these specimens being collected in May and June.

HABITS.

It seems to be a well known fact that this pest occurs only in cities and towns, and has never been reported from this State as causing damage to vineyards or arbors located in the country.

As the caterpillars feed in the day time and are exposed, it makes it a rather easy pest to control; they are also very local in their injury, this outbreak being confined to a very small area. Inasmuch as the adult is a day-flyer and because of its local habits, it should be effectually controlled if proper treatment be given when the larvae are first found feeding. They are very voracious leaf feeders, and if the foliage has been sprayed with arsenical poisons it will prove very destructive to them.

LIFE HISTORY.

The adult, or moth, generally appears in Connecticut during the months of May and June, and probably lays its eggs soon after it emerges from the ground.

The young caterpillars are whitish in appearance and feed beneath the leaves, growing very rapidly. The caterpillar when full grown goes into the ground to pupate about the first of August. This year a majority had pupated on August 2. It changes into a chrysalis within a slight cocoon, just below the surface of the ground. In Connecticut the insect passes the winter in the chrysalis stage, the adult appearing the next spring and having one brood. In Missouri, however, Riley* reports that the adult issues soon after it changes from the larva to the chrysalis form, also that there are two broods annually in Missouri, and that a third brood was obtained in Illinois in 1870. J. B. Smith† reports but one brood in New Jersey, and Lugger‡ also reports that this species is single brooded in Minnesota and passes the winter in the pupal stage.

* Riley, Sixth Annual Report of State Ent. of Mo., 1874, page 95.

† Smith, Economic Ent., page 263, 1896.

‡ Lugger, Minnesota Insects, Bull. 61, page 121, 1898.

DESCRIPTION.

Egg. The egg of this pest has never been observed by the writer and consequently cannot be figured or described here.

Larva. The average length of the full grown larvae is 35 mm. The general color of the larvae is brown with a bluish cast. The head and cervical shield are of a shiny bright deep orange, covered with several black dots. The segments are transversely banded with narrow black and whitish bands, each segment having a broader band of orange. This orange band is sometimes lacking on the second and third segments, and is interrupted in the center of the seventh, eighth, and ninth segments. The orange band is dotted with small black dots; even when the bands are not present on the second and third segments, the black dots are present. Each dot produces a short white hair, and they are arranged in two rows, alternating in the rows. Between the orange bands, the black and white transverse lines appear. The eleventh segment has a prominent hump, and laterally between the tenth and eleventh segments appears a whitish spot, which is larger than the white markings that appear between the other segments just below the spiracles. These markings give the appearance of a wavy whitish line, which is only broken by the interruption of the orange bands. The legs are black; the false legs have two black spots near the bases which are orange.

Chrysalis. The larva changes to its chrysalis within a slight cocoon, which is made of particles of soil or sand and measures about three-fourths of an inch in length. The chrysalis is dark brown in color and measures one-half inch in length.

Adult. The female moth is of a deep velvety blue-black color. The forewings have two large circular pale yellow spots, and the hind wings two smaller white spots. The shoulder-covers are yellow, and the first and second pairs of legs are tufted with orange. The male moth differs slightly from the female, having larger wing spots in proportion to its size, and it also has a white mark on the tip of its abdomen. The abdomen of the female is entirely black. Females in the station collection have a wing-expanse of one and three-eighths inches; the males average one and one-fourth inches.

The larvae, pupae, adults and parasite are shown on plate XI.

PARASITES.

Undoubtedly many different species of birds feed upon these caterpillars and help largely to keep this pest in check. In the laboratory two Tachinid parasites emerged August 15, and were identified by Mr. Harrison E. Smith as *Winthemia quadripustulata* Fabr. Whether this is an important parasite that will keep the insect in check another year remains a question.

CONTROL METHODS.

Hand picking has been recommended as a control method where the caterpillars appear in small numbers and when arsenical sprays cannot be used to advantage. Spraying with arsenate of lead, three pounds in 50 gallons of water, is very effective, one spraying being sufficient in most cases. Pyrethrum in the form of a spray, two ounces to a gallon of water, will prove effective, especially if applied when the caterpillars are small. London purple is an old remedy which was much used in New York City about 1890, being recommended by E. B. Southwick, who had charge of the trees and shrubs in Central Park.

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THE PINE TIP MOTH.

Pinipestis zimmermani Grote.

During the course of the work of inspecting the white pine plantations by the botanical and forestry departments, on account of the blister rust, early in the summer of 1916, many infested pines were found and destroyed. Sections of the trees contain-

ing the fungus were placed in heavy paper bags and brought to the Station. These were stored in the botanical laboratory, where a few weeks afterward several small moths were observed on the windows. These were collected and examined and were found to be two species, *Pinipestis* (*Nephopteryx*) *zimmermani* Grote and *Dioryctria abietella* D. & S. As they were suspected of having emerged from some of the pine wood, subsequent material was placed in cages and several adults obtained. These emerged from sections of the trunk often three inches or more in diameter. This moth was reared from material gathered in Bantam, Litchfield County; New Canaan, Cannon Station, and Bridgeport, in Fairfield County; Middlebury, New Haven County; Groton, New London County; and Woodstock, Windham County. These records indicate that this insect occurs throughout the State.

INJURY.

This insect is supposed to attack the base of the new growth, causing a brown pitch mass to form, and later the tip shrivels and finally turns brown. According to both Grote and Kellicott, q. v., it also attacks the bark of the trunk and larger branches, especially in the vicinity of wounds, often killing small trees. The former expressed the opinion that this insect caused more injury to young white pines than any other species.

Though this insect is known as the pine tip moth, Professor Kellicott* observed it breeding in the vicinity of wounds on the trunks of trees from six to twelve inches in diameter. He also found the larvae near galleries made by other borers and found their galleries in both trunk and branches above and below the whorls, sometimes completely girdling the stem and killing the upper portion. Particularly was the injury of this moth apparent in connection with the tunnels of the white pine weevil, *Pissodes strobi* Peck.

LIFE HISTORY.

There has been no opportunity for us to work out the life history of this insect, but Kellicott* states that he took many larvae on April 12, varying from .25 to .7 of an inch in length, so apparently the insect winters in the larval stage, and trans-

* Canadian Entomologist, Vol. xi, page 114, 1879.

forms to the pupal stage in early summer. The first of our adults emerged June 27, but others came out later up to August 5. Probably there is only one brood each year.

FOOD PLANTS.

This moth is known to infest the following species of pines:—white pine, *Pinus strobus*; *P. rubra*; red or Norway pine, *P. resinosa*; Scotch pine, *P. sylvestris*; stone pine, *P. cembra*; Bhotan or Japanese white pine, *P. excelsa*; and the Austrian, Corsican, and Russian pines.

DESCRIPTION.

Adult. Wing-expanse, 1.-1.25 inches; forewings less than one-fourth of an inch wide at widest part, ground color gray sometimes brownish, marked transversely with zigzag lighter and darker lines, as shown on plate XII, b. Rear wings nearly unicolorous, light brown, darker along the veins and near the margins. Body gray, rear margin of each abdominal segment bordered with whitish scales. Antennae brown, filiform; legs black and white.

Larva. The larval stage was not observed as we did not know that this insect was present until the moths emerged. Grote* states that the larva when full grown is from 16 to 18 mm. long and "livid or blackish green" with shining chestnut brown head and black mandibles. Its body is naked with series of black dots, each dot giving rise to a single rather stout bristle. Prothoracic shield blackish. Kellicott,† on the other hand, states that the larvae were dull white instead of "livid or blackish green," and that the hairs arise from brown instead of blackish dots.

TREATMENT.

So far as known there is no practicable method of control. It is always advisable to destroy, during the winter or early spring, trees or portions of trees which are known to be infested.

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THE PARALLEL SPITTLE-INSECT ON PINE.

By B. H. WALDEN.

The parallel spittle-insect, *Aphrophora parallela* Say, has been quite abundant on pines in the forest plantation at Rainbow during the past two or three seasons. The presence of this insect is indicated by conspicuous masses of white froth one-half to three-fourths of an inch long on the twigs usually near the tips.

The spittle-insects belong to the order Hemiptera, family Cercopidae. The immature stages are passed in these froth masses and the injury to the plants is caused by sucking out the juices or sap. At least two species are very abundant during certain seasons on grasses, and probably cause considerable damage. Other species, like the parallel spittle-insect which attacks pines, cause more or less injury to various trees and shrubs, though usually much less abundant than those attacking grasses.

In 1915, the froth masses of the parallel spittle-insect were first observed on May 28; the insects at this time were a little over 4 mm. in length, which would indicate that they were in the second stage or instar. On June 30, two adults were collected on pitch pine trees and several pupa skins were observed. The insects in a number of the froth masses at this time were about 6 mm. long and were probably only in the fourth instar.

From froth masses collected on the station grounds on June 19, adults emerged on June 22 and 26. Adults in the station collection have been taken in the field from June 30 until August 10.

At Rainbow this insect was most abundant on pitch pine, but many froth masses were found on white pine and Scotch pine, and a few were observed on Norway spruce planted among the pines. No froth masses were found on Austrian pine, red pine, or Jack pine.

While these insects have often been very abundant, and their injury has been observed for years, very little has been published

regarding their habits and life histories until Professor Osborn published the results of his recent studies in 1916.* The different stages of *A. parallela* are described and figured in this publication but the only food plant mentioned is Scotch pine. Packard† and Felt‡ mention pitch pine or hard pine, and Smith§ records the species in New Jersey as occurring throughout the state (June to September) on the white pine and pitch pine, and probably it infests other species.

The adult of the parallel spittle-insect and the froth masses caused by the nymph are shown on plate XIII.

ANTI-MOSQUITO WORK IN CONNECTICUT IN 1916.

By W. E. BRITTON and B. H. WALDEN.

During 1916 considerable interest has been shown in mosquito elimination work, and the largest single contract ever awarded for this kind of work in Connecticut was executed in Branford, Guilford, and Madison, and now the salt marshes between Branford River and Hammonasset River, about 2,668 acres, are wholly ditched. Other salt marshes near New Haven and in Saybrook were also ditched, making a total of about 2,900 acres of salt marsh in the State which was ditched in 1916, making this the banner year since anti-mosquito work was started in 1912.

All ditches cut in 1912 and subsequently have been maintained in good working condition. Several improvements have been made affecting fresh swamps where malaria mosquitoes breed. These operations are described in detail in the following pages:

WORK OF THE CONNECTICUT SHORE MOSQUITO EXTERMINATION ASSOCIATION, INC., BRANFORD, GUILFORD, MADISON.

Approximately 2,668 acres of salt marsh along the Connecticut coast were ditched in 1916 to eliminate mosquito breeding. This area extends from the Branford River on the west to the Hammonasset River on the east, including the salt marsh east of the

* Maine Agr. Exp. Station, Bull. 254, page 279, 1916.

† U. S. Ent. Commission, Fifth Report, page 741, 1890.

‡ Insects Affecting Park and Woodland Trees, Vol. ii, page 686.

§ Insects of New Jersey, page 98, 1909.

Branford River in the town of Branford and all of the salt marsh in the towns of Guilford and Madison. The acreage of marshes drained in these towns is approximately as follows:

Branford	578	acres
Guilford	1,085	"
Madison	1,005	"
	2,668	"

The money to do this work was furnished by the Connecticut Shore Mosquito Extermination Association, Incorporated. This association was formed during the early part of the year and the money was raised by private subscription.

The association was desirous of having the work maintained by the towns as provided in the law passed at the last session of the Legislature. In order to take advantage of this provision it was necessary that the ditching work be done under the direction of the Director of the Agricultural Experiment Station and approved by him. Under the above law it is necessary for the Director to publish an order for such work in a newspaper having a circulation in the locality where the work is to be done. The order must be published three times, the first publication to be at least ten days before work is started. This is in order that the property owners may apply for relief from any damage that they may consider will be done to their property by the ditching. The appeal, according to the law, shall be made within ten days after the order for the work is first published. Consequently the order for this work was first published on March 16, 1916, in the Shore Line Times of Guilford, and the areas to be drained were indicated on maps, which were filed in the Town Clerk's office of each town where the work was to be done.

No appeals were filed by any of the property owners in the territory to be drained.

Owing to late snows and the general condition of the marshes at that time, it was not practicable to make a preliminary survey of the area at that time. The association was anxious to have the work started immediately without waiting for any survey to be made, and furthermore did not care to provide funds for such a survey.

The contract for the work was awarded to the U. S. Drainage and Irrigation Company, 17 Battery Place, New York, and the

work was started on March 28, 1916, twelve days after the publication of the first notice or order concerning the work. The task of inspecting the ditches was assigned to Mr. B. H. Walden.

The ditching was started in Branford at the west end of the territory, and the association immediately requested the contractor to start work in each town, so as to facilitate the collection of pledges from the residents. The contractor, therefore, placed men at Stony Creek and others on the Hammonasset marsh in Madison at the extreme eastern end of the section. This was done without consulting the Director of the Station or the inspector, and proved to be a serious handicap in the matter of inspecting and approving the work.

The Skinner spade, which makes a ditch ten inches wide and twenty-four inches deep, was used for cutting all the new ditches.

Soon after the work started objections were made by many of the marsh owners regarding the ditching. The boundaries between the various pieces of marsh property were frequently marked only by ditches. In a majority of cases these ditches had become filled with mud or clogged with vegetation. Some were so grown up that the exact location could be determined only with difficulty. There was no way to distinguish these boundary ditches from the others, and the contractor preferred to cut new ditches a few feet from the old ones. This arrangement was not only to his advantage, but the new ditches are usually more satisfactory from the mosquito elimination standpoint. New ditches drain more readily, keep their shape much better, and the cost of maintenance is much less than where old ditches are cleaned.

The owners also objected to having the marshes cut up into small sections, which interferes considerably in harvesting the salt hay. As this was the first mosquito drainage work under the present law, it seemed advisable to proceed with as little opposition from the marsh owners as possible. Therefore, considerable time was spent by the inspector and the contractor's foreman in meeting the farmers and locating the ditches as far as possible to their satisfaction. Thus many old boundary ditches were cleaned instead of digging new ones.

The work was considerably delayed owing to the contractor not being able to obtain more laborers, and a number of marsh

owners in Guilford objected to having their marshes ditched in June after the grass was well started. As some of these marshes were fairly dry with few mosquito-breeding areas, it was agreed to postpone the ditching until after the hay had been cut.

These excepted marshes were situated in three places: the upper part of the West River marsh above the Sachem's Head road, the East Creek marsh above the railroad tracks, and the upper end of the East River marsh above the main highway.

BRANFORD MARSHES.

The most important problem in Branford was the marsh east of the road to Indian Neck. The marsh extends eastward back of Hotchkiss Grove and another portion extends to the north. The surface is lower than the outer marsh towards the outlet. Just below the road was an old tide gate, which had not been repaired for several years and which failed to keep the water out. On the east side of the road a gate had previously been built in the trolley embankment to replace the old one. Though this gate was in good repair, the trolley embankment was built of rocks and gravel, and the water seeped through it for a distance of fifty or more feet, so that the water level on the marsh was not under these conditions materially lowered.

This marsh was extremely soggy with large shallow pools and much standing water in the grass areas, and was a prolific salt marsh breeding area furnishing a mosquito nuisance for the entire section from Indian Neck to Pine Orchard. The marsh was ditched in April, the contractor putting in as many ditches as were practicable owing to the soft condition of the marsh. After this, while the water did not flow in and out of the ditches freely, most of the surface water was concentrated in the ditches. Frequent inspections of the marsh were made during the season and but very little mosquito breeding was found. A tide gate was apparently necessary to lower the water in order thoroughly to drain the marsh. It was decided that the best place for a tide gate was south of the road where the old gate was located. Therefore, a pair of new gates were built and hung on the old frames, which appeared to be in fairly good shape. After placing the new gates it was soon found that they would not close tightly against this frame. The abutments on either side of the gate

also leaked considerably. Later a new frame was made of four by six inch lumber to support the gates, and fastened to the outside of the old frame. Sheet piling was placed from the edges of the frame and in front of the abutments and the space between packed with clay. After this the gates worked satisfactorily excepting when blocked with eel-grass and weeds. Owing to lack of maintenance this was removed several times either by the contractor's foreman or by the inspector.

Towards the end of the season additional ditches were cut in the marsh and many of those cut earlier in the season were cleaned. The marshes in the eastern part of Branford were well supplied with natural creeks and were, therefore, readily drained by the ditching.

GUILFORD MARSHES.

West of Leete's Island Station and north of the railroad and highway there is a marsh of about twelve acres, which was low and soggy, breeding many mosquitoes. The outlet is through a long, crooked culvert under the highway, where it passes under the railroad. After the marsh was ditched it was found that the water did not drain out readily, and owing to the soft texture of the marsh some of the ditches were partially closed up. On August 1 additional ditches were dug, and the outlet and opening of the culvert cleaned and deepened. After this was done the water drained out and the condition of the marsh was much improved, no breeding being found there after August 1.

North of Island Bay (or Joshua Cove as it is locally known) is a marsh of about 50 acres. Between the marsh and the water on the southwest side is a large sand bar and a strip of high land over which the Stony Creek and Guilford trolley line passes. At one time the outlet of this marsh was probably near the eastern end of this sand bar, but for years the only outlet has been a ditch to the north across the highway and for several hundred feet along the southern side of the railroad embankment and then through a twenty-four-inch pipe under the railroad into the marsh northward, where a ditch was indirectly connected with the creek draining the Great Harbor meadows, a distance from the upper end of the Island Bay to the mouth of the Great Harbor Creek of about a mile and a quarter. This marsh was found to be a serious mosquito-breeding area in 1904, when a preliminary mosquito survey of the Connecticut coast was made.

A photograph showing haystacks standing in water on this marsh taken in August, 1904, was published in the Report of this Station for 1904, plate XIV, a.

It was found that an outlet could be made into Island Bay east of the sand bar where it would be protected by the rocky shore. The contractor and the owners of the marsh agreed with us that the most practicable way to drain the marsh was by opening an outlet at this point. After the ditch had been cut here, the tides flooded the upper end of the marsh which was six to eight inches lower than the southern portion. The owners felt that the water would ruin the salt hay and demanded that a gate be placed at the outlet. The contractor held that it was not a part of his contract to build tide gates, but finally agreed to build one. It was later found necessary to enlarge and lower the culvert under the trolley tracks. Considerable work was done in cleaning and deepening the outlet to the north. A new twenty-inch ditch was dug from the upper end of the railroad culvert eastward to the main creek in order to obtain more direct drainage.

MADISON MARSHES.

On the lower part of the large East River marsh the ditching was inspected early in July. At this time the marsh had dried out and was considered in good shape. When any breeding was found, the places were eliminated by filling or by cutting spur ditches. At the time of the August perigee the tides were unusually high each day for over two weeks. Every depression in the marsh was filled with water, and mosquito larvae were very abundant. While much of the water drained away before adults emerged, it was found necessary to do considerable more work filling and tapping pools. The same condition occurred on some of the other large marshes. In fact during this same period similar trouble was experienced on certain marshes which were drained in 1912, and which had been practically free from breeding for four years.

Within this section are a number of small marshes just back of the Madison beach, which had no adequate outlets. To carry off the water it was necessary to put in eight box culverts varying from fifteen to one hundred and fifty feet in length.

The provision for a permanent outlet for the marsh of about sixteen acres west of the West Wharf road is an engineering problem requiring the expenditure of several hundred dollars. The only place for an outlet was through the exposed sandy beach where the waves break with much force, shifting large quantities of sand during the spring and fall. The culvert put in during the past season is adequate to drain the water from the marsh, but it is a question whether it will stay in place during the winter storms.

The portion of the large Hammonasset marsh west of the Hammonasset River in the town of Madison forms the eastern boundry of the area included in the contract. This marsh was ditched during May and the early part of June. The work was inspected, and after a certain amount of perfecting work was done, practically no breeding occurred during July. Following the rains and high tides of August considerable breeding, especially on the lower portion, developed, and a large amount of additional perfecting work was done, including filling pools and cutting spur ditches.

RESULTS OF THE WORK.

When the height of the mosquito breeding season arrived, there were still many areas to be ditched and a large proportion of perfecting work yet remained to be done. But in spite of these facts the number of mosquitoes was greatly reduced, and the results of the work were apparent over the entire area. This fact was admitted by many of the residents and summer boarders, who were familiar with the mosquito conditions of past seasons. That the summer hotels were better patronized is indicated by the conditions of one house that was brought to the attention of the writers. During 1915 this hotel was practically empty twice during the mosquito-breeding season, and the management offered special inducements to the guests. During 1916 this hotel was filled during the whole season and was obliged to turn away many applicants.

SUMMARY OF THE WORK.

Approximately 2,668 acres of salt marsh in the towns of Branford, Guilford, and Madison were ditched during 1916 to eliminate mosquito breeding. The work was started March 28

and completed November 20. About 1,200,000 feet of new ditches were dug and old ditches cleaned. One new tide gate was built and one old tide gate was repaired. Twelve box culverts from 15 feet to 175 feet long were built. The whole or larger part of 81 days were spent by the inspector interviewing the marsh owners, inspecting the work, etc.

NEW HAVEN AND ORANGE.

Maintenance work.

The Anti-Mosquito Committee of the Civic Federation of New Haven has each year raised money for the maintenance of the ditches cut during the past few years. This committee engaged Mr. P. L. Buttrick to start the cleaning of the ditches early in the season, but as Mr. Buttrick was later given a more important position as inspector of a large ditching contract at Lawrence, Long Island, Mr. J. W. Draper of West Haven was employed for the remainder of the season (June 15 to September 15) in and around New Haven, on maintenance and inspection work.

New Ditching Work.

In 1916 the funds of this committee were sufficient to maintain the old ditches and leave some money available for new ones. In ditching additional areas it seemed best to expend the money where it would do the most good. As the amount available was small, it was not sufficient to ditch the lower portion of the Quinnipiac marsh nor the marsh on the east side of the New Haven harbor north of Fort Hale Park. On the other hand there still remained an undrained area in the West River marsh which we considered as one of the most prolific sources of salt marsh mosquitoes near New Haven. This area was situated on the west side of the river in the town of Orange, between Spring Street and Congress Avenue. In West Haven some interest had been aroused and a committee appointed to raise funds and promote anti-mosquito work. Dr. Charles D. Phelps was chairman of this committee. Thus by the coöperation between these two committees, sufficient money was available to ditch this area which contained about 90 acres. The West Haven committee raised \$150.00, and the remainder was

supplied by the New Haven committee, the total cost being \$396.75 for cutting 15,870 lineal feet of ditches at 2½ cents per foot. The necessary legal notice was published by the Director of this Station in the New Haven Journal-Courier under date of August 29, 1916. The work was done by the United States Drainage and Irrigation Company of New York, N. Y., and on account of the scarcity of labor was considerably delayed. It was finally started on November 23 and finished on December 6. It was inspected and the ditches measured by Mr. Walden. Thus all salt marsh is now ditched south of the Congress Avenue bridge in the West River meadows.

Dr. Phelps and his committee also raised money and arranged to ditch the lower portion of the Old Field Creek marsh. The Director's order and notice was first published in the New Haven Sunday Register, December 10, 1916. There were no protests or appeals, but at the time of this writing the work had not been done. It was planned to cut 9,000 to 10,000 feet of ditches between Beach Street and Blohm Street.

Dredging of Morris Creek.

Some of the ditches at Morris Cove, cut in 1912, did not perform their work properly on account of a defective tide gate. A new tide gate was finished in 1915, but even then the water did not drain out of the ditches satisfactorily, and it was decided that the main outlet, Morris Creek, should be dredged below the tide gate. The money was, therefore, raised, the contract awarded, and it was expected that the work would be done in September, but for some reason it was delayed and the writers are informed that the dredging will be done early in the spring. After the main channel has been deepened, it will be necessary to clean out the old ditches above the tide gate. These ditches were cut in 1912 and have been cleaned somewhat and examined many times, but as they have been filled with water much of the time, it was impossible to clean them thoroughly, and, if possible, would do little good. Still there has not been much mosquito breeding in this locality. With the creek deepened sufficiently to allow the ditches to empty at low tide, they can be put in first class condition and properly maintained.

Appropriation by City of New Haven.

In the estimates of 1917, which were allowed by the Board of Finance and later adopted by the Board of Aldermen, is an item of \$10,000.00 for mosquito extermination. This was asked for in the estimates of the preceding year, but was disallowed.

Ten thousand dollars will probably be sufficient to ditch all the remaining unditched salt marsh areas now existing in New Haven, and may provide for some ditching in the West River meadows north of the Congress Avenue bridge, where the marsh is of a fresh character. Some malarial mosquitoes doubtless breed in this section, which at any rate should be given some attention.

The principal sources of mosquitoes for New Haven are as follows:

Quinnipiac Marsh. The lower part lies in New Haven, and is an intensive breeding place for salt marsh mosquitoes, especially along both sides of the Middletown turnpike.

Mill River Marsh. This is a small marsh lying between the State Street bridge and East Rock. It has never been an important mosquito-breeding place, though many people seemed to regard it as such. Now the land has all been acquired by the city for park purposes, and is rapidly being filled. The Park Department will see that this area is cared for, and if additional ditches are needed, will cut them, so that none of this appropriation is needed in the Mill River marsh.

Harbor Marsh. On the east side of the harbor there is a salt marsh area of 120 acres or more, situated north of Fort Hale Park, which has never been adequately ditched. Most of this land is owned by Mr. G. H. Townshend, who has cut ditches from time to time for the purpose of increasing the yield and improving the quality of salt hay. Nevertheless, more ditches are needed, and at present this is one of the most serious breeding places of salt marsh mosquitoes existing in the southerly part of the city. Relief can be obtained only by a treatment of this area.

Beaver Swamp. Though many improvements have been made in this vicinity by the Park Department, this still remains the most constant source of malarial mosquitoes around New Haven. They breed in the grassy edges of the clear water

streams and springs. Some of the surface is oiled each year, but it is still not difficult to find the larvae during the latter part of summer. Some of the land is still in the hands of private owners, and before any comprehensive plan can be carried out it will be necessary for the city to purchase considerable property. This \$10,000.00 appropriation would be entirely inadequate here, and moreover whatever is done should be along the lines of permanent park development. It is much more than a simple ditching problem.

West River Meadows. These meadows have now all been ditched below Congress Avenue, but above Congress Avenue as far north as Derby Avenue, and even to Chapel Street on the eastern side of the stream, there are lagoons and springs with clogged outlets. As this water is largely fresh, these places are doubtless furnishing some malarial mosquitoes each year. Adequate ditches should be cut connecting these places with the main stream, and the old lagoons cleaned of weeds and rubbish.

SAYBROOK.

During the latter part of the summer Honorable M. G. Bulkeley let a contract for ditching two areas of salt marsh at Fenwick in the town of Saybrook. About 32,000 lineal feet of ditches were cut and the total area probably amounts to over 50 acres. Much more salt marsh in the vicinity needs ditching, but a start has been made, and it is to be hoped that the work will not end here.

HAMDEN.

Through the efforts of the Health Officer, Dr. George H. Joslin, the town appropriated \$300.00 for anti-mosquito work. Several pools and swamps in the Highwood section were filled with factory waste without expense to the owners or to the town. A fresh water swamp near Mill Rock and adjoining Lake Whitney has for years been a breeding ground for malarial mosquitoes, and malaria has been prevalent in the vicinity. Through the coöperation of the New Haven Water Company and the Winchester Repeating Arms Company, owners of the land, mosquito breeding will soon be abolished. By raising the dam of Lake Whitney about 18 inches the Water Company will flood about 50 acres of its own swamp land. The Winchester Repeat-

ing Arms Company is building a dam and pumping station by means of which the water will be pumped into Lake Whitney from a swamp of about 50 acres. Thus the two projects together will abolish mosquito breeding in a swamp of about 100 acres, formerly a prolific source of malaria mosquitoes.

ENTOMOLOGICAL FEATURES OF 1916.

The first part of the preceding winter was mild followed by severe weather and low temperature in February, which killed the peach buds on trees in the orchards back a few miles from the coast. During the spring and early summer, it was cool with heavy rainfall, so that crops were backward. On account of the rainy weather and scarcity of labor, work was behind on farms and in many cases the crops were not given attention at the right time. Up to July 1, the rainfall was greatly in excess of that of 1915 and was also above the normal, but for the remainder of the season, it was somewhat below normal.

There were complaints of wireworm injury to the roots of crops in some parts of the State. There was a certain amount of white grub injury, though less than in 1915. Cutworms were generally common and caused the usual amount of damage.

The striped cucumber beetle, *Diabrotica vittata* Fabr., was more abundant and caused more damage at the Station farm at Mt. Carmel than the writer has ever seen elsewhere.

Certain kinds of aphids were prevalent. The rosy apple aphid caused considerable injury in orchards here and there, but the green aphid seemed to be less prevalent than in 1915. The aphids on seed beets mentioned in the Report of this Station for 1915, page 191, were also present in 1916, and a brief account of the control measures, which were given a successful trial, will be found in the pages of this Report. The most notable aphid outbreak of the year was that of the turnip aphid, *Aphis pseudo-brassicæ*, Davis, which seemed to cover nearly the whole State and caused damage to the turnip crop probably amounting to thousands of dollars. For a more comprehensive account of this insect and how to control it, see page 98 of this Report.

Rose chafers were also abundant and caused the usual amount of damage to grapes and other fruits, as well as to ornamental trees, shrubs, and flowers.

One of the features of the season was the great amount of injury to apples caused by the false or lined red bug, *Lygidea mendax* Reuter, which has heretofore been noticeable only in the southwestern corner of the State. In 1916, however, it was much more widespread and destructive. It was reported from Litchfield, Glastonbury, and Mansfield, and no doubt could be found all over the State. The writer saw rather severe injury from it in Milford.

The apple maggot, *Rhagoletis pomonella* Walsh, was also very abundant and caused serious damage.

The brown-tail moth has failed to spread its usual distance during the year and winter webs are now rather scarce. Nowhere have they been found abundant.

The gipsy moth has not spread perceptibly from the infestations known to exist in the summer, but since the fall scouting began a large number of small infestations consisting mostly of single egg-clusters have been found along the eastern border of Thompson and some occur in Putnam and Killingly.

The first portion of the season was favorable, as regards rainfall, for the development of mosquitoes and they were abundant. Considerable ditching was done on the salt marsh during the year, amounting to about one and a quarter million lineal feet, thus effectively draining about 2,900 acres. This is the most ever done in a single year in Connecticut. More work is planned for next season.

More detailed information regarding these insects will be found in the pages of this Report.

MISCELLANEOUS INSECT NOTES:

Scale Insect on Azalea. On July 26, we received from Hartford a rhododendron twig infested with a few large, light-gray scales occurring on the bark. These were identified by the Bureau of Entomology at Washington, D. C., as *Eriococcus azaleæ* Comstock.

Moths in Sap Bucket. On April 6, we received from Mr. George W. Best, Higganum, specimens of moths, with a statement that they were present in large numbers in maple sap. Thirty-five were found in one bucket. The specimens were too

badly crushed for accurate specific identification, but evidently belonged to the genera *Xylina* and *Scopelosoma*.

A Rare Long-Horned Beetle. Another addition to the Connecticut collection of beetles was made at Middlebury on June 2, 1916, in a specimen of *Anthophilax malachiticus* Hald. This large, metallic, bluish-green, long-horned beetle, about one-half inch long, was found walking across the road in a damp place. It is probably a wood-boring species and has been taken in Canada, Maine, New York, and Connecticut.—M. P. ZAPPE.

European Elm Case Bearer. On June 16, leaves of Camperdown elm were received from Fairfield, which showed several holes and also several peculiar larvae in their brown cases, known as case bearers. This is apparently the European elm case bearer, *Coleophora limosipennella* Dup., which has previously been recorded in Brooklyn and New York City by Slingerland* and Felt.† It is said that this insect is spreading and the injury increasing. Spraying with lead arsenate, as is usually practiced to control the elm leaf beetle, ought to prevent serious injury by this case bearer.

Another Spruce Gall Aphid in Connecticut. While making the annual inspection of nurseries, in two nurseries in Hartford, September 20-22, large galls were noticed on specimen trees of the Colorado blue spruce. These galls are caused by *Chermes cooleyi* Gillette, a species not hitherto recorded from the State. Plate XV, b, shows the shape of the gall. If remedial measures are necessary, probably a contact spray early in spring, as is used against the common spruce gall aphid, *Chermes abietis* Linn., would be effective.

Injury by Silver Fish. Specimens of a species of silver fish, *Thermobia domestica* Pack, were brought to the office on September 14, from Hartford where they caused much damage by gnawing paper, book bindings, etc. It is often necessary to try different remedies before success is reached. Boiled starch paste poisoned with arsenic and distributed on cloth or bits of cardboard placed around in the crevices where the silver fish

* Bulletin 233, Cornell Agr. Expt. Station, page 49, 1905.

† Insects Affecting Park and Woodland Trees, Vol. 1, p. 167, 1905.

occur, will sometimes prove effective. Pyrethrum or insect powder can also be used where it can be applied.

A Scolytid Beetle in Sugar Maple. On July 10, a section of the trunk of a small sugar maple tree was received from Pomfret with a number of small, deep tunnels in the wood. In these tunnels were several beetles which were identified as *Xyleborus dispar* Fabr. The accompanying letter stated that for several years this beetle has been at work in one part of one maple tree. The species is known to attack many different kinds of trees including fruit trees, but remedial measures, other than destroying the infested tree, are of questionable value.

The Eyed Elater. The largest click beetle occurring in Connecticut, known as the eyed elater, *Alaus oculatus* Linn., on account of the two large eye spots on the thorax, was seemingly more common than usual in 1916, and was sent to the office several times between June and November from New Haven, Hamden, Orange, and Hartford. The correspondent usually asks if this is a pest. We are obliged to answer, No. The larvae are found in decayed wood such as old logs, stumps, etc., and it can scarcely be called an injurious insect. The adult is shown on plate IX, a, photographed from a living specimen.

Abundance of Walnut Caterpillar. The walnut caterpillar, *Datana integerrima* G. & R., which has been mentioned in former reports (see Reports of this Station for 1901, page 275; 1914, page 191), was also prevalent in 1916. Specimens were received several times from New Haven, West Haven, Wallingford, Meriden, Chester, and New Canaan. The caterpillars feed in clusters upon butternut, black walnut, and hickory, and have the habit of gathering in large numbers on the trunks and larger branches at molting time. Consequently the large gray masses of cast skins are noticeable on the bark. Spraying the tree or destroying the clusters of larvae by hand are remedies.

Tarnished Plant Bug Injuring Tobacco. During July a complaint was received from Mr. R. H. Gardner, Cromwell, regarding a form of injury to tobacco caused by a small sucking bug, which was doing much damage. In order to make sure of the identity of the insect responsible, specimens were re-

quested. It proved to be the tarnished plant bug, *Lygus pratensis* Linn., an old offender, which has caused much injury in past years to various fruit, flower, and vegetable crops. It is a difficult pest to control, but if taken in season a thorough spray of "Black Leaf 40," one pint in 50 gallons of water, to which has been added two pounds of laundry soap, should prove effective. Mr. Gardner claimed that in 1916 this insect caused damage in his tobacco fields to the amount of \$500.00.

The Greenhouse Leaf-Tyer. Larvae of the greenhouse leaf-tyer, *Phlyctania ferrugalis* Hübn., were received from Norwalk, January 4, 1916, where they were doing much damage to snap-dragon, geranium, and cineraria by devouring the leaves. A note about this insect occurs in the Report of this Station for 1909, page 369. The larva is shown in figure 7, and the adult on plate XVI, b, of that report. The food plants include nearly all of the common vegetables, many native weeds, and a large number of ornamental herbaceous plants growing both under glass and out of doors. A good remedy is to apply paste lead arsenate at the rate of one pound in ten gallons of water. Small potted plants can be dipped in this mixture, but in spraying it is necessary to coat the under side as well as the upper surface of the leaves.

Flea Beetle on Ash. During the spring inspection of white pines for white pine blister rust, a flea beetle, *Ædionychis sexmaculata* Ill., not previously reported from Connecticut, was found at Middlebury feeding on ash (*Fraxinus*). These beetles are oblong-oval in shape, in color reddish or brownish yellow. They have the last joints of the hind tarsi globosely swollen and the hind thighs thickened for leaping. Size, about one-eighth of an inch long. On June 7, 1916, there were many beetles feeding on the ash sprouts which were growing between the rows of pine, almost defoliating some of them. There was much ash growing among the pines, but it was considered worthless because the pines would soon outgrow and kill it. Where ash is used as a shade tree or is grown for lumber, these beetles may become of some economic importance.—M. P. ZAPPE.

California Privet Injured Supposedly by White Grubs. On April 8, specimens of white grubs, *Lachnosterna* sp., were

brought to the office from Wallingford, with the statement that they were causing considerable injury in a small nursery by eating the bark of California privet just below the surface of the ground. Some plants had been killed, many had been girdled, and others had been eaten on one side and a callus had formed around the wound. The owner had about 35,000 plants which he had grown from cuttings. He transplanted 5,000, and found that almost every plant had been attacked. Mr. Zappe visited this nursery April 10, and found many injured plants and but few white grubs. The owner was advised to throw the soil up around the stems of the plants to induce them to make roots above the girdled areas. When the nursery was again inspected in the fall there was a good stand of plants.

Sucking Dog Louse. On May 9, several specimens of the sucking dog louse, *Hæmatopinus piliferus* Burm., were received from Fairfield, where one of several pet dogs, a beagle hound, was infested. All of the dogs slept in the same barn, but the others seemed to be free from lice. Several remedies such as flea powder, creolin, and whale oil soap were tried, but were not very effective. Kerosene and water and a thorough combing kept them down for a week or so, when they appeared again. The owner was advised to obtain some paraffine oil about 28° gravity, and to saturate thoroughly the hair and skin of the dog, and then to wash it off with soap and water an hour or so later. A subsequent letter from the owner stated that this proved a perfect success, and two such treatments a month apart completely routed the pest.

The Grape-Vine Sawfly. Larvae were received on July 15 from Wilton, and on August 26 from Bridgeport, where they were feeding on the under side of grape leaves. This insect is known as the grape-vine sawfly, *Erythraspides pygmæus* Say. It is not much of a pest in Connecticut. The larvae when mature are about a half-inch in length, greenish yellow, with head and tip of the body black, and with two transverse rows of black spots on each segment. The larvae feed in colonies, and are shown on plate XVI, b. There are two broods each season. The adult is a small, four-winged fly. Though this insect seldom causes much injury in Connecticut, it can be controlled when

abundant by spraying the grape leaves with lead arsenate, using three pounds of the paste in fifty gallons of water.

***Euclemensia bassettella* Clem., a Micro-Lepidopteron Bred from Scale Insects.** Specimens of a *Kermes* probably *K. sassceri* King., were collected on an oak at Yalesville, April 13, 1916, by B. H. Walden. On examining this material during the summer four specimens of a small moth were found in the box, and in the scales were holes from which the moth emerged. See plate XII, c. The moth proved to be *Euclemensia bassettella* Clem. This species was described by Dr. Clemens* from Connecticut material sent to him by Mr. H. F. Bassett, of Waterbury. The original description is as follows:

"*H. bassettella*. Fore wings bright reddish-orange, sometimes tinted with yellowish-orange, with a black spot at base above the fold of the wing, and a broad black stripe, showing bluish or greenish reflections, along the inner margin, extending from the middle of the fold to the tip of the wing and occupying nearly one-half of the breadth of it. Along the costa, about the middle of it, is a shining black stripe, which becomes narrower as it approaches the apical third of the wing. Cilia blackish. Hind wings shining, dark greenish black. Head and thorax black. Antennae black. Labial palpi, yellowish-orange."—B. H. WALDEN.

Shot-Gun Cartridges Injured by White Ants. Some paper shot-gun cartridges were sent to the laboratory, September 28, by the Winchester Repeating Arms Company of New Haven. These shells had been eaten, evidently by some insect, in much the same manner as another lot received in 1910 which had been injured by ants. (See Report of this Station for 1909-1910, page 698.) The present shipment was returned from a dealer in Wichita, Kansas. In some cases the shells were eaten so that the powder and shot rattled out into the box. An examination of this material revealed the presence of a few dead and immature white ants, probably *Leucotermes flavipes* Kollar, a common and destructive species in the more northern latitudes where white ants are found. This species is native to the United States and often breeds in old logs, stumps, posts, or any timber near the ground. It frequently tunnels in the construction timbers of trestles, bridges and buildings, sometimes seriously weakening

* Proceedings Entomological Society of Philadelphia, Vol. ii, page 423, 1864.

them. The termites probably were tunneling where the cartridges were stored and, not realizing their dangerous character, ate into the shells.

A Worm Reported from Milk. A Hartford dairyman brought to the office on March 18 a whitish larva which was alleged to have been found in milk by one of his customers. This proved to be a full grown larva of the cadelle, *Tenebrioides mauritanicus* Linn. It is about three-fourths of an inch long, whitish, with head and anal segment dark brown; there are also brown dorsal markings on the three thoracic segments. This insect feeds upon all kinds of stored vegetable foods and has even been reported from milk,* but may have occurred there accidentally. Its presence should not necessarily be considered as evidence that the milk was adulterated with farinaceous material. In the Hartford case, however, the customer admitted that the bottle had been opened and that milk, sugar, and barley flour had been used in the preparation for a patient. In straining, the larva was found upon the strainer. The flour was sifted, and no more worms were found. It was thought that this one came from the milk. The habits of this species lead us to believe that, though the larva may have fallen into the milk, it is even more probable that it was in the barley flour or the sugar.

Twigs Girdled by the Giant Hornet. On June 17, some small hard wood twigs, which had been girdled, were received from Stamford. This appeared to be the work of the giant hornet, *Vespa crabro* Linn., and our opinion was later confirmed by Dr. E. P. Felt, to whom the sample was submitted. On November 7, apple twigs which had been similarly injured were received from Greenwich, and this injury had been followed by the woolly aphid. Dr. Felt† states that this insect has attracted considerable attention during the last few years by gnawing the bark from the living twigs of various trees, birch being attacked oftener perhaps than other kinds. This hornet is a native of Europe, but has been collected many times in Connecticut in recent years at New Haven, Hamden, Darien, and Plantsville. It was first noticed in the vicinity of New York City more than twenty years ago,

* Insect Life, Vol. i, page 112, 1888.

† Thirtieth Report of New York State Entomologist, page 71, 1915.

and has now spread into southern Connecticut and throughout New Jersey. In Europe this hornet is recorded as stripping the bark from the twigs of ash, alder, elm, linden, lilac, oak, larch, horse chestnut, willows, and poplars. Though this injury is usually slight and needs no control measures, in case of choice specimen trees and shrubs grown for ornament it may be advisable to coat the bark with lead arsenate, using one pound in ten gallons of water.

The Hickory Gall Aphid. Each year the compound leaves of various species of hickory begin to fall in June. If the stems are covered with galls, as shown on plate XV, a, it is an indication that the cause of dropping is due to the hickory gall aphid, *Phylloxera caryæcaulis* Fitch. The work of this insect is always evident in New Haven, and during the past season it was also received from Middlebury and Darien. The galls occur on the new shoots and leaf stems in June, and are bullet-shaped or pointed-globular and are sessile on the stems, which are usually more or less deformed. The galls vary from less than one-fourth to an inch or more in diameter, though usually between one-fourth and one-half inch. Those growing singly are the largest, but when crowded they are often confluent and are much smaller. At the time the leaves fall the galls are open at the point and blackened inside. Earlier these galls are nearly filled with immature aphids. Apparently the winter is passed in the egg stage, and there is only one gall-producing brood each season. These galls can form only when the tree is making its season's growth. Several varieties have been described, but these varieties are at least in part due to the particular species of hickory on which they occur and not to the insects responsible for the galls. Sometimes many leaves fall, and it seems as though much injury must result, but certain trees on the Station grounds are attacked each year, and though a portion of the leaves and some of the new shoots drop, some are not infested, and some only slightly infested, and these remain upon the trees. The vigor of these trees does not seem to be greatly impaired. Requests for remedies are constantly received, and though not supported by any records of evidence, it is possible that if sprayed with kerosene emulsion or nicotine solution just as the buds are breaking open in the spring, choice shade trees may be protected from attack.

Curious Galls on Grape-Vines. Each year we receive a number of specimens of galls from grape vines with a request for information about the cause and seriousness of the trouble. The commonest gall on grape is known as the grape vine tomato gall, *Lasioptera vitis* Osten Sacken, and several specimens were sent to the office during the summer from New Haven, North Haven, and Meriden. This gall is an irregular, watery thickening or swelling, usually occurring on the new shoots, sometimes involving the stem and often the leaves, petioles, and the tendrils. These swellings are usually red, sometimes green, and they are often confluent. Their appearance is shown on plate XVI, a. Of course, these galls are conspicuous and affect the growth of the shoot on which they occur. But usually only part of the shoots are affected and the vine makes ample growth in spite of them.

A similar, though more regular, and usually larger, gall is found on the stems of wild grapes. This is the grape vine apple gall, *Schizomyia pomum* Walsh and Riley, formerly known as *Lasioptera vitis-pomum*. On August 16, a specimen of this gall was received from Meriden. This gall is formed from a bud and is borne sessile on the side of the stem. In shape it resembles a small peach, the end being pointed, and it is about five-eighths of an inch in length. It is usually green or reddish, and is much more common on wild grapes than upon the cultivated varieties.

There is no treatment which can be recommended to prevent the formation of these galls. The parent two-winged flies lay the eggs on or in the succulent tissues, the galls grow and contain cells in which the larvae develop. The only known means of control is to clip off and burn the infested tips.



a. New out-door insectary.



b. View at farm showing protectors over cucumber plants.

NEW INSECTARY, AND VEGETABLE INSECT EXPERIMENTS.



a. The westernmost infestation, Ashford.



b. Woodland infestation, No. 18, Pomfret; 304 egg-clusters were found here, and 4000 gallons of spray mixture used.



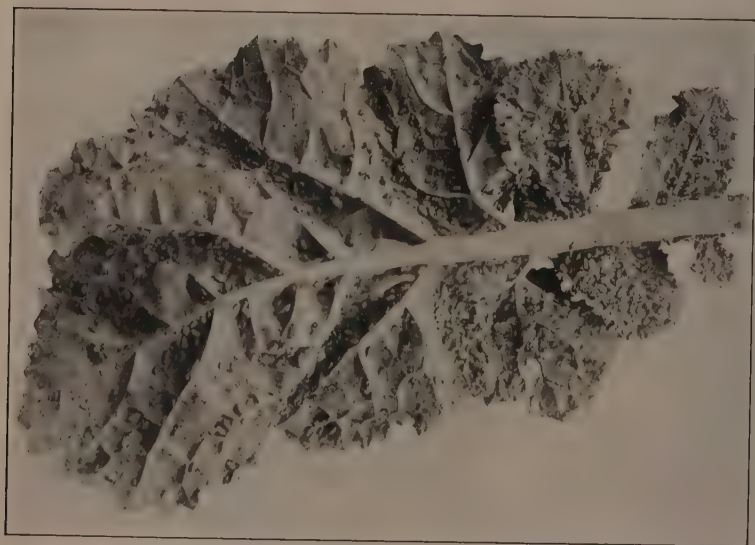
a. Creosoting egg-masses, infestation No. 1, Brooklyn.



b. Spraying woodland trees, Thompson.



a. Spraying woodland trees, gipsy moth work, Thompson.



b. Turnip leaf infested with aphids, natural size.

GIPSY MOTH WORK AND TURNIP APHID.



a. Turnip field. White egg turnips at right had been killed by aphids; rutabagas at left were beginning to show injury.



b. Aphids killed by fungus, enlarged six times.

TURNIP APHID.



White-marked tussock moth. Cocoons and egg-masses.



a. Egg-masses.



b. Male moth.



c. Female moth and egg-masses.

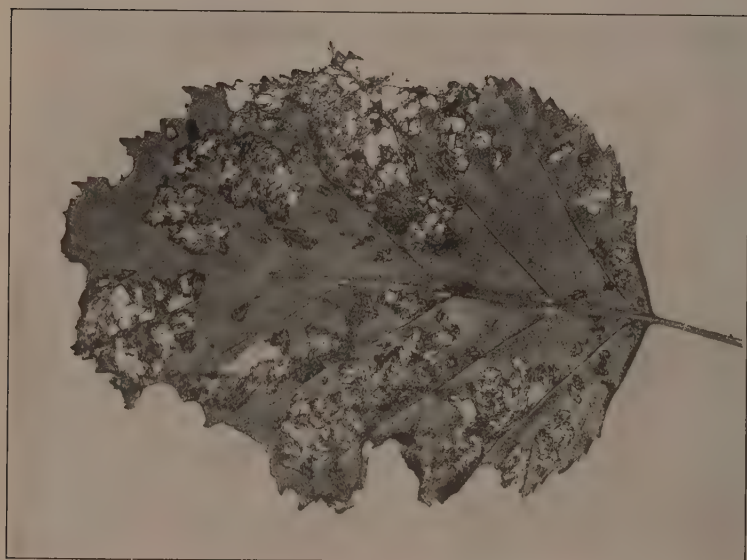


d. Caterpillars feeding on apple leaf.

WHITE-MARKED TUSOCK MOTH, ALL NATURAL SIZE.



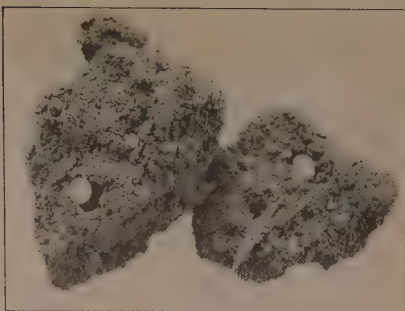
a. Adult beetles injuring rose, natural size.



b. Birch leaf eaten by beetles.



a. Eyed elater, *Alaus oculatus*
Linn., natural size.



b. Eggs of rose chafer, two and one-half times enlarged.

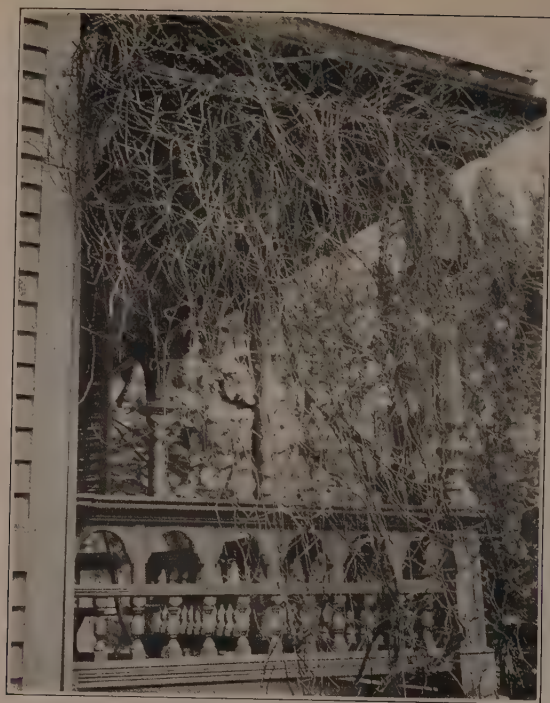


c. Rose chafer, twice natural size.



d. Peaches eaten by the rose chafer.

WORK OF ROSE CHAFER, AND EYED ELATER.



a. Virginia creeper stripped by larvae.



b. Grape-vines defoliated by the larvae.

WORK OF THE EIGHT-SPOTTED FORESTER.



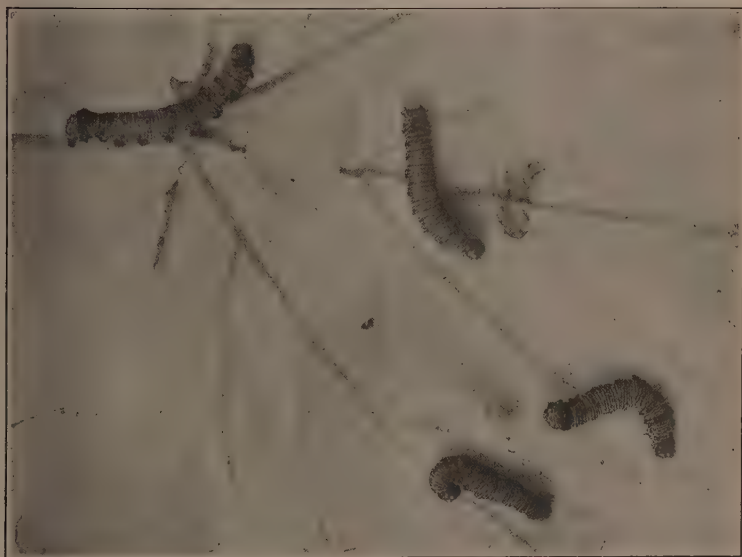
a. Pupae, natural size.



b. Tachinid fly, *Winthemia quadripustulata* Fabr.
Twice natural size.

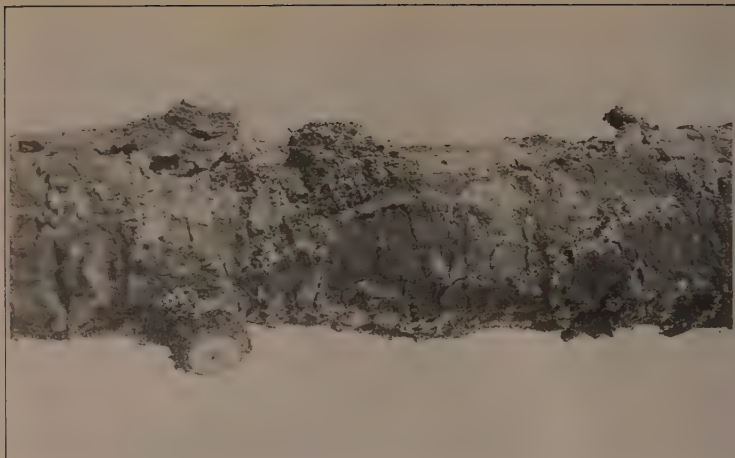


c. Adults and larvae, natural size. Female at top.



d. Larvae feeding on grape leaf. Natural size.

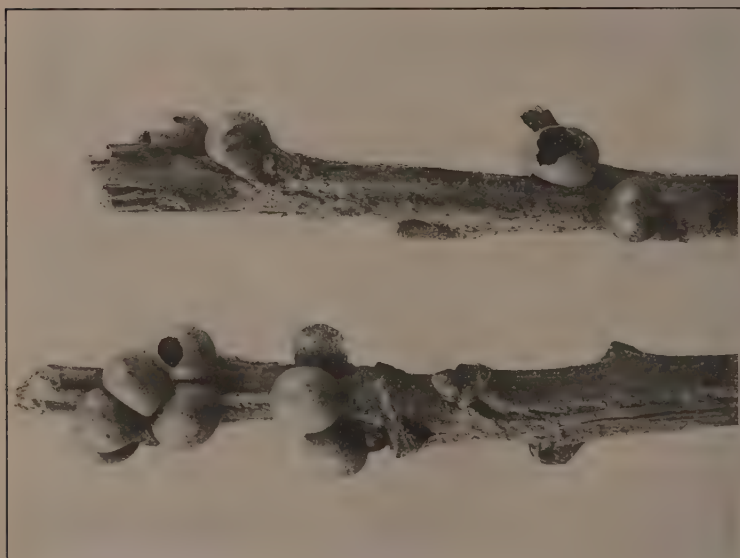
EIGHT-SPOTTED FORESTER.



a. White pine infested by larvae of pine tip moth, natural size.



b. Adult of pine tip moth, *Pinipestis zimmermani* Grote. Natural size.



c. Scale-insect, *Kermes sassceri*, infested with *Euclemensia bassettella* Clem. Twice natural size.

PINE TIP MOTH, AND INFESTED SCALE-INSECT.



The froth masses on Scotch pine are natural size. The insert shows the adult insect, four times enlarged.

PARALLEL SPITTLE INSECT.

PLATE XIV.



a. Ditching gangs at work, near Stony Creek.



b. View on Hammonasset Marsh, Madison, showing ditch.

ANTI-MOSQUITO WORK.



a. Galls of hickory gall aphid, natural size. Typical *Phylloxera caryæcaulis* at right, var. *spinosa* at left.



b. Galls of aphid, *Chermes cooleyi* Gillette, natural size.

HICKORY AND SPRUCE GALLS



a. Grape-vine tomato gall, *Lasioptera vitis* O. S. Natural size.



b. Larvae of the grape-vine sawfly, *Erythraspides pygmaeus* Say. Natural size.

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